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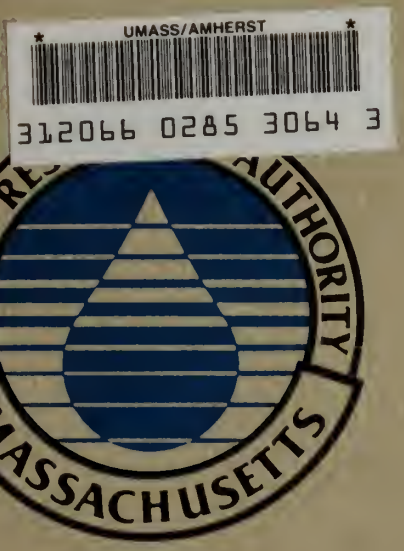

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Secondary Treatment Facilities Plan

Volume III
Appendix K

Traffic Impact Analysis

January 7, 1988

Secondary Treatment Facilities Plan

Volume III
Appendix K

Traffic Impact Analysis

January 7, 1988

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Attachment A-Existing Condition Service Level

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1.0 SUMMARY

1.1 TRAFFIC - CONSTRUCTION OF TREATMENT PLANT

Transportation requirements to Deer Island and Nut Island for the construction of preliminary, primary, secondary, disinfection, and support facilities for the new 500 mgd plant include initial transport of construction equipment, periodic transport of materials to and from the island, and daily transport of workers to and from the sites during all phases of construction. Traffic associated with these activities will be minimal. The following sections detail the analysis of traffic during the construction of the treatment facilities.

During the approximate 8-year period for treatment facilities' construction (1991 to 1999), the estimated average daily requirement for construction workers will range from 155 to 670 with a peak range of 205 to 875. Estimated average daily truck trip volumes to the on-shore piers will range from 20 to 110 with a peak range of 40 to 180. Truck trip volumes were determined using 22 cubic yards, or 20 tons, of material per truck load. It is possible that some or all of the construction materials will be loaded onto barges at docking facilities close to supply sources for transport over water to Deer Island and Nut Island. This could reduce truck volumes by as much as 40 percent. Peak worker needs will occur in 1992 and 1993 during primary treatment facilities construction, and in 1996 and 1997 during secondary treatment and aeration facilities construction. Peak truck trip volumes will occur from 1992 through 1993 and from 1996 through 1997 and are directly related to facility construction schedule overlaps.

The minimal traffic impact during treatment facilities construction is a result of several abatement measures intended to alleviate the possibility of unmanageable traffic conditions on local roads in Winthrop. To alleviate the volume of construction worker vehicles on local roads, half of the workers will be transported to Deer Island via ferry from remote docking facilities; the remainder will be bussed to and from Deer Island using satellite parking facilities. The MWRA is committed to limiting the trucking volumes through Winthrop to Deer Island after pier construction to no more than eight small service trucks per day. The remainder of the equipment and materials deliveries will be made via barge to the new pier facilities. Since the overall levels of service are not anticipated to decrease with the addition of construction vehicles during early site preparation, then it can be expected that the addition of eight trucks per day to existing volumes will be negligible.

1.2 PARKING ASSESSMENT

Due to the logistical constraints associated with the Deer Island Wastewater Treatment Plant, construction activities will present some unusual transportation problems. Deer Island is connected to the mainland by a causeway. The causeway is accessed by a network of local roads passing through the town of Winthrop. Earlier investigations have indicated that an arrangement allowing unrestricted access to Deer Island by automobiles during construction activities would give rise to unacceptable traffic management problems in Winthrop. Therefore, construction workers seeking access by land will have to do so by traveling to satellite parking areas for transfer to the site by bus. Construction worker transport over water by

ferry has been addressed in previous reports to MWRA, and impacts associated with this operation will not be considered here. This analysis will address the overland transport of workers who cannot conveniently access the ferry landing locations and must access the site by land.

For the purpose of analysis and impact assessment, it has been assumed that as much as half of the total workforce required at Deer Island may seek access by land. For the most part, these workers will be coming to the site from the eastern, northern, and northwestern parts of the metropolitan Boston region.

Of the options available to employ the satellite parking facilities and subsequent busing to the site, the one which now appears most attractive would be to extend the operating authority of the bus company currently serving Winthrop to allow scheduled vehicles to service designated parking facilities along or near the MBTA Blue Line through East Boston and nearby communities.

Parking for approximately one-half of the construction work force could be accommodated by linking three satellite parking areas to Deer Island by bus. This report outlines the assessment method used to determine the available options for development and use of satellite parking facilities.

Eight candidate sites were selected based on location and present use. Each was subjected to twelve general screening criteria. These screening criteria and the five sites which were not selected are described, in detail, in this appendix. The three facilities which best meet the general criteria are the Orient Heights Blue Line Station, the Suffolk Downs Race Track, and the Metropolitan District Commission (MDC) lot north of Wonderland. All of these sites are easily accessible through the existing road network and are close to Deer Island and to each other.

The Orient Heights MBTA Blue Line Station is located in East Boston and has parking facilities northeast of the intersection of Bennington and Saratoga Streets. These facilities currently serve Blue Line commuters and are filled to capacity each day. The lot can be improved to provide an additional 50 parking spaces. Most workers using the Blue Line to commute to satellite facilities would disembark at this location.

The Suffolk Downs Race Track is located south of Winthrop Avenue in Revere and can be reached from the Suffolk Downs and Beachmont MBTA Blue Line Stations. The race track has a capacity of approximately 3,000 parking spaces. At least one-fourth, or 750, spaces could be available for Deer Island worker parking.

The Metropolitan District Commission parking lot is located on Ocean Avenue south of Revere Street and is just north of the eastern portion of the Wonderland MBTA parking facility which currently serves the Blue Line commuters. The MDC lot can be marked to hold approximately 800 parking spaces, half of which could be available for Deer Island worker vehicles without reducing the space currently used by commuters.

Each of the three recommended satellite parking areas is described in greater detail in the

following sections.

Satellite parking at these locations could provide a combined capacity of approximately 1200 parking spaces for worker vehicles. All three sites are accessible by automobile and by public transit. It is anticipated that most workers will travel to the parking areas by automobile. Intersections in the vicinity of the three sites that could be affected by the additional construction worker automobile traffic have been identified. These intersections have been analyzed to determine existing levels of service and to ascertain whether the increased construction traffic would reduce these service levels. In all cases, the service level remains unaffected by the additional traffic. The detailed intersection analysis can be found in the following sections.

A bus service operating plan has been devised which would facilitate the proximity of the parking sites to each other and take advantage of the bus service that already exists in the area. Bus service to the three sites would occur along two routes with no more than one bus per stop at any one time. Approximately three Route 1 buses and four Route 2 buses are needed in the peak periods. The service interval is 15 minutes and buses travel at an average speed of 15 mph. Route 1 cycle time is 45 minutes and Route 2 cycle time is 50 minutes including allowance time for bus stop worker transfer. One-way trip travel time between Deer Island and satellite areas would not exceed 30 minutes. Buses would be scheduled at intervals throughout the day with shorter intervals during the shift changes and longer intervals between shift changes. The following sections describe the bus service operating plan in greater detail.

Finally, plant administration and operation and maintenance personnel will also use the satellite parking areas and proposed busing plan to access Deer Island. This will involve the transport of approximately 300 workers on a daily basis for the life of the treatment plant. Both Suffolk Downs Race Track and the MDC Lot have space to accommodate plant personnel parking requirements.

1.3 CUMULATIVE TRANSPORTATION IMPACTS

Cumulative transportation impacts resulting from all known MWRA construction activities including the Deer Island Secondary Treatment Facilities are presented in Table K-1. Cumulative peak worker and truck volumes for Deer Island construction are presented in Figures K-1 and K-2 respectively. Construction of the facilities at Deer Island will commence in 1988 and will continue through 1999, while work at Nut Island will occur between 1990 and 1995. Worker and truck requirements have been examined for early site preparation, the inter-island conveyance system, the treatment facilities and the outfall (Site 5.0). Other MWRA projects include Fast-Track, House of Corrections, and Pier projects, in addition to several other MWRA projects that will be occurring within this period of time. These projects include the Interim Scum Project, Interim Sludge Project, Sodium Hypochlorite Disinfection, Trunk Sewer, Interim Residuals Management and Final Residuals Management. The preliminary traffic volumes used to identify cumulative traffic were calculated using the following information or sources:

- o Fast Track - (HAVENS & EMERSON, 1987)
- o Piers - Facilities Plan and EID, Volume 7, On-Island Water Transportation Facilities (October, 1987)
- o House of Correction - numbers estimated by MWRA.
- o Interim Scum - Deer Island numbers based upon an estimated $100,000 project cost. Nut Island numbers estimated by MWRA.
- o Interim Residuals/Sludge - Deer Island numbers based upon an estimated $4 million project cost. Nut Island numbers based upon an estimated $3 million project cost.
- o Sodium Hypochlorite Disinfection - numbers estimated by MWRA.
- o Trunk Sewer - numbers estimated by MWRA.
- o Residuals 1 and 2 - numbers based upon an estimated $252 million project cost.

Typical construction breakdowns were used to project worker and truck volumes from estimated project costs. Traffic volumes associated with these projects are included in the cumulative totals.

The highest worker volumes at Deer Island will occur between 1992 and 1997, which corresponds to the peak construction periods for the treatment facilities, the outfall and the inter-island conveyance system. The average number of workers ranges from 242 to 1439 per day and the peak number of workers ranges from 258 to 1714 per day during the construction period. At Nut Island, the highest worker and worker vehicle volumes occur between 1990 and 1994. The average number of workers ranges from 10 to 169 per day, and the peak ranges from 15 to 194 per day. Approximately 50% of the volumes at Nut Island are attributable to operations and maintenance personnel, which decrease significantly in 1995 when treatment operations end.

The highest truck volumes at Deer Island will occur between 1991 and 1995. The average number of trucks will range from 30 to 275 per day and the peak number of trucks will range from 81 to 370 per day. Truck volumes associated with work at Nut Island will range from 9 to 310 per day between 1990 and 1995. All materials movements have been uniformly estimated on the basis of a unit truck shipment. Bulk shipment of certain materials such as cement, aggregate, excavation materials, etc. would reduce the estimated total truck movements by 35 to 45 percent.

With the completion of the pier facilities in 1991, as many as 600 workers and all shipments and deliveries, not including a contingency trucking of 8 vehicles per day, will be shipped to Deer Island via ferry and barge from remote docking facilities. This is described in more detail in the Facilities Plan and Environmental Information Document for On-Shore Water Transportation Facilities. The remainder of the workers will be transported to the site by bus

from satellite parking areas. Satellite parking is discussed in greater detail later in this report.

It is expected that the majority of construction work will be a two-shift operation, with the exception of influent and effluent conduit tunnel boring and lining work which will operate on four overlapping eight-hour shifts. Plant operation and maintenance and House of Correction workers will work three shifts. The highest worker volumes at Deer Island are expected from 1992 through 1997; however, there is not a direct correlation with the overall worker volumes and worker shift change volumes. The peak worker shift change volume is expected in the third quarter of 1996; the overall peak worker volume is expected in the first quarter of 1995. Critical time periods for worker shift change volumes are expected to be 1992 to mid-1993 and 1995 through 1997. The maximum number of workers will need parking at the satellite parking facilities, which are described in the following section, during the above times and are defined by the arrival of one shift and the departure of another. The recommendations for satellite parking provide for an adequate number of parking spaces to accommodate these vehicles at the facilities.

TABLE K-1

SUMMARY OF TRAFFIC MOVEMENTS
MWRA SECONDARY TREATMENT FACILITIES PLANNING

OTHER PROJECTS:

	YEAR	DEER ISLAND WORKERS AVERAGE	PEAK	NUT ISLAND WORKERS AVERAGE	PEAK	DEER ISLAND TRUCKS AVERAGE	PEAK	NUT ISLAND TRUCKS AVERAGE	PEAK
Fast Track	1988	81	117			10	15		
	1989	81	117			10	15		
Piers	1988	6	14			4	8		
	1989	76	108			4	8		
House of Correc.	1988	148	148						
	1989	148	148						
Interim Scum	1988	5	6	13	20	-	1	300	300
	1989			47	62			-	1
Interim Sludge/ Residuals	1990	31	41	47	62	6	13	-	1
	1991	31	41			6	13		
Conv. to NaOCl	1989	20	25			2	5		
Trunk Sewer Rehab.	1988	4	5						

TABLE K-1

SUMMARY OF TRAFFIC MOVEMENTS
MWRA SECONDARY TREATMENT FACILITIES PLANNING

(continued)

YEAR	DEER ISLAND WORKERS AVERAGE	PEAK	NUT ISLAND WORKERS AVERAGE	PEAK	DEER ISLAND TRUCKS AVERAGE	PEAK	NUT ISLAND TRUCKS AVERAGE	PEAK
OPERATIONS AND MAINTENANCE:								
1988	84	87	74	81	18	22	9	10
1989	84	87	76	83	17	20	9	10
1990	84	87	86	93	17	20	9	10
1991	94	97	86	93	17	20	9	10
1992	94	97	86	93	17	20	9	10
1993	94	97	86	93	17	20	9	10
1994	358	403	86	93	17	20	9	10
1995	377	391	10	15	13	15		
1996	377	391	10	15				
1997	377	391	10	15				
1998	440	480	10	15				
1999	461	480	10	15				

TABLE K-1

SUMMARY OF TRAFFIC MOVEMENTS
MWRA SECONDARY TREATMENT FACILITIES PLANNING

(continued)

YEAR	DEER ISLAND WORKERS AVERAGE	PEAK	NUT ISLAND WORKERS AVERAGE	PEAK	DEER ISLAND TRUCKS AVERAGE	PEAK	NUT ISLAND TRUCKS AVERAGE	PEAK
RESIDUALS 1 AND 2:								
1991	208	270			20	40		
1992	203	264			20	40		
1993	132	171			20	40		
1994	100	130			20	40		
1995	210	280			20	40		
1996	180	240			20	40		
1997	232	312			20	40		
1998	90	118			20	40		
1999	100	130			20	40		
EARLY SITE PREPARATION								
1988	91	91			2	3		
1989	91	91			2	3		
1990	91	91			2	3		

TABLE K-1

SUMMARY OF TRAFFIC MOVEMENTS
MWRA SECONDARY TREATMENT FACILITIES PLANNING

(continued)

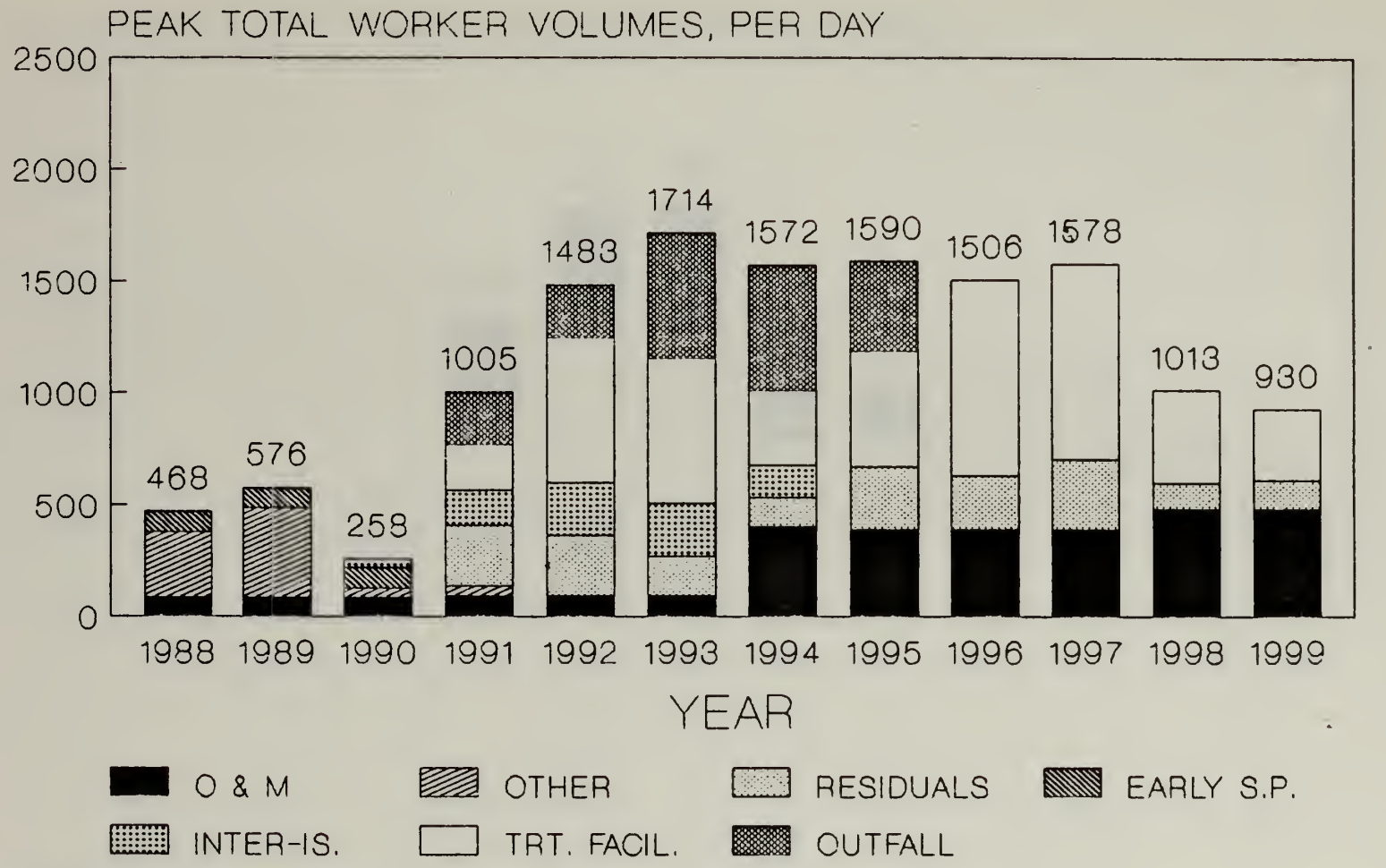
YEAR	DEER ISLAND WORKERS AVERAGE	DEER ISLAND WORKERS PEAK	NUT ISLAND WORKERS AVERAGE	NUT ISLAND WORKERS PEAK	DEER ISLAND TRUCKS AVERAGE	DEER ISLAND TRUCKS PEAK	NUT ISLAND TRUCKS AVERAGE	NUT ISLAND TRUCKS PEAK
INTER-ISLAND WASTEWATER CONVEYANCE SYSTEM:								
1990	36	39	36	39	5	5	3	5
1991	140	156	36	39	36	45	3	5
1992	212	236			33	40		
1993	212	236			33	40		
1994	130	144			20	25		
TREATMENT FACILITIES								
1991	155	205			20	40		
1992	495	650	55	70	100	160	10	20
1993	495	650	55	70	100	160	10	20
1994	255	335	55	70	55	75	10	20
1995	395	515	55	70	75	105	10	20
1996	670	875			95	170		
1997	670	875			95	170		
1998	320	415			50	90		
1999	245	320			40	70		

TABLE K-1

SUMMARY OF TRAFFIC MOVEMENTS
MWRA SECONDARY TREATMENT FACILITIES PLANNING

(continued)

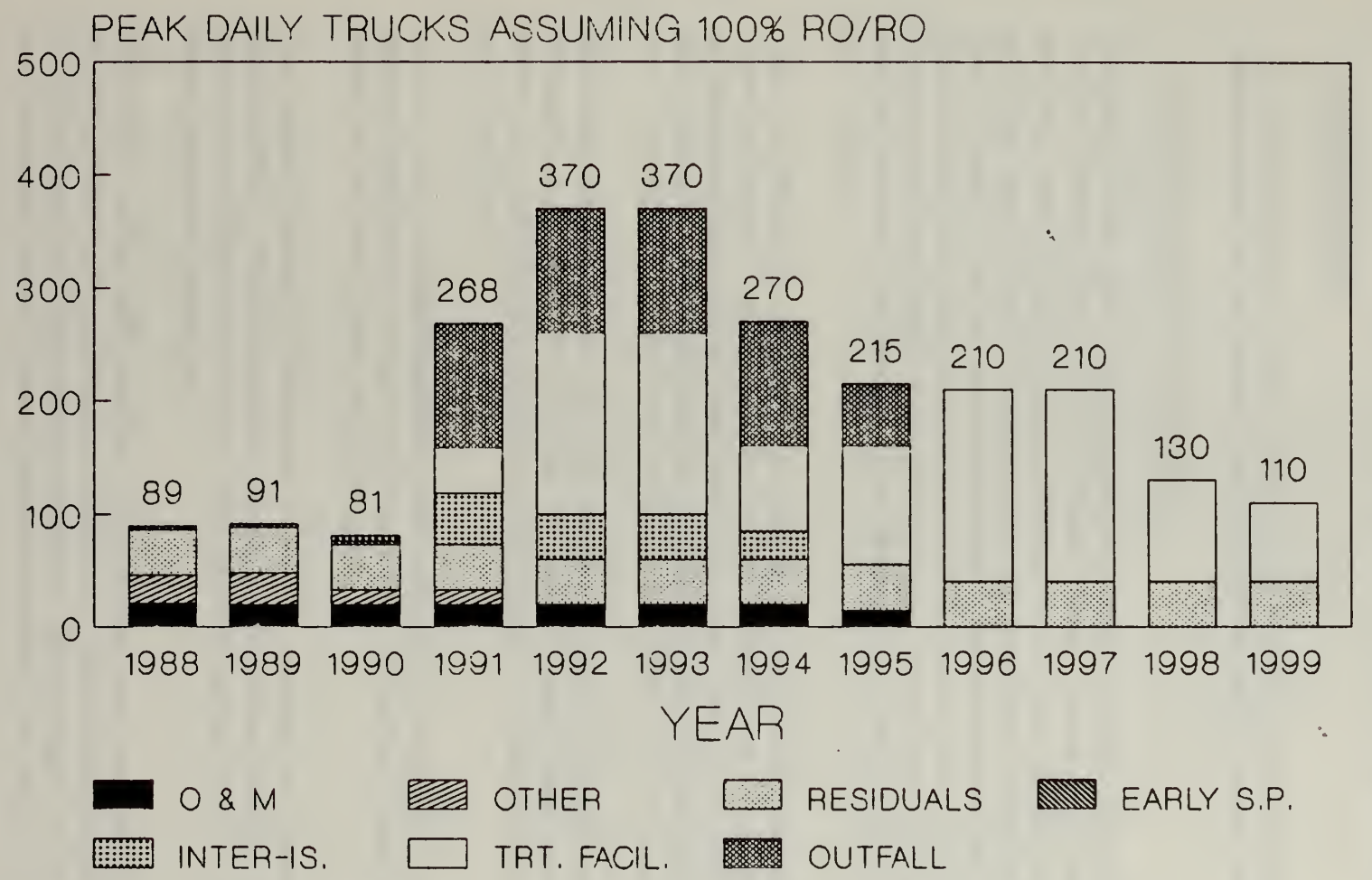
YEAR	DEER ISLAND WORKERS AVERAGE	PEAK	NUT ISLAND WORKERS AVERAGE	PEAK	DEER ISLAND TRUCKS AVERAGE	PEAK	NUT ISLAND TRUCKS AVERAGE	PEAK
OUTFALL (SITE 5.0)								
1991	163	236			105	110		
1992	212	236			105	110		
1993	506	560			105	110		
1994	442	560			105	110		
1995	67	404			50	55		
TOTAL OF ALL PROJECTS, INCLUDING OPERATIONS & MAINTENANCE:								
1988	419	468	87	101	34	89	309	310
1989	500	576	123	145	35	91	9	11
1990	242	258	169	194	30	81	12	16
1991	791	1,005	122	132	204	268	12	15
1992	1,216	1,483	141	163	275	370	19	30
1993	1,439	1,714	141	163	275	370	19	30
1994	1,285	1,572	141	163	217	270	19	30
1995	1,049	1,590	65	85	158	215	10	20
1996	1,227	1,506	10	15	115	210		
1997	1,279	1,578	10	15	115	210		
1998	850	1,013	10	15	70	130		
1999	806	930	10	15	60	110		



OTHER PROJECTS - FAST TRACK, PIERS, HOUSE OF CORREC, INT SCUM, INT SLUDGE, NaOCl CONV, AND TRUNK SEWER

MASSACHUSETTS WATER RESOURCES AUTHORITY

FIGURE K-1
CUMULATIVE PEAK WORKER TRAFFIC TO DEER ISLAND



OTHER PROJECTS - FAST TRACK, PIERS, HOUSE OF CORREC, INT SCUM, INT SLUDGE, NaOCl CONV, TRUNK SEWER

MASSACHUSETTS WATER RESOURCES AUTHORITY

FIGURE K-2
CUMULATIVE PEAK TRUCK TRAFFIC TO DEER ISLAND

2.0 TRAFFIC IMPACT ANALYSIS METHODOLOGY

2.1 INTRODUCTION

This appendix describes the existing Winthrop traffic environment, the analysis method used in evaluating impacts, and the impacts of treatment plant construction transport operation.

2.2 EXISTING TRAFFIC ENVIRONMENT

Land access to Deer Island is by a causeway that connects the island to the mainland. The island is within the corporate boundary of Boston. Access to the causeway, however, is by local roads passing through the town of Winthrop.. Route 145 does not pass through the central part of town where the downtown business district and town hall are located, but rather circumnavigates it. The route provides general access from the north and west, over Bennington Street, Saratoga Street, Main Street, Pleasant Street, Washington Avenue, Veterans Road, Winthrop Shore Drive, Crest Avenue and Revere Street. On the western side, the crossing of Belle Isle Inlet leads to East Boston. On the northern side, a similar crossing leads to the town of Revere.

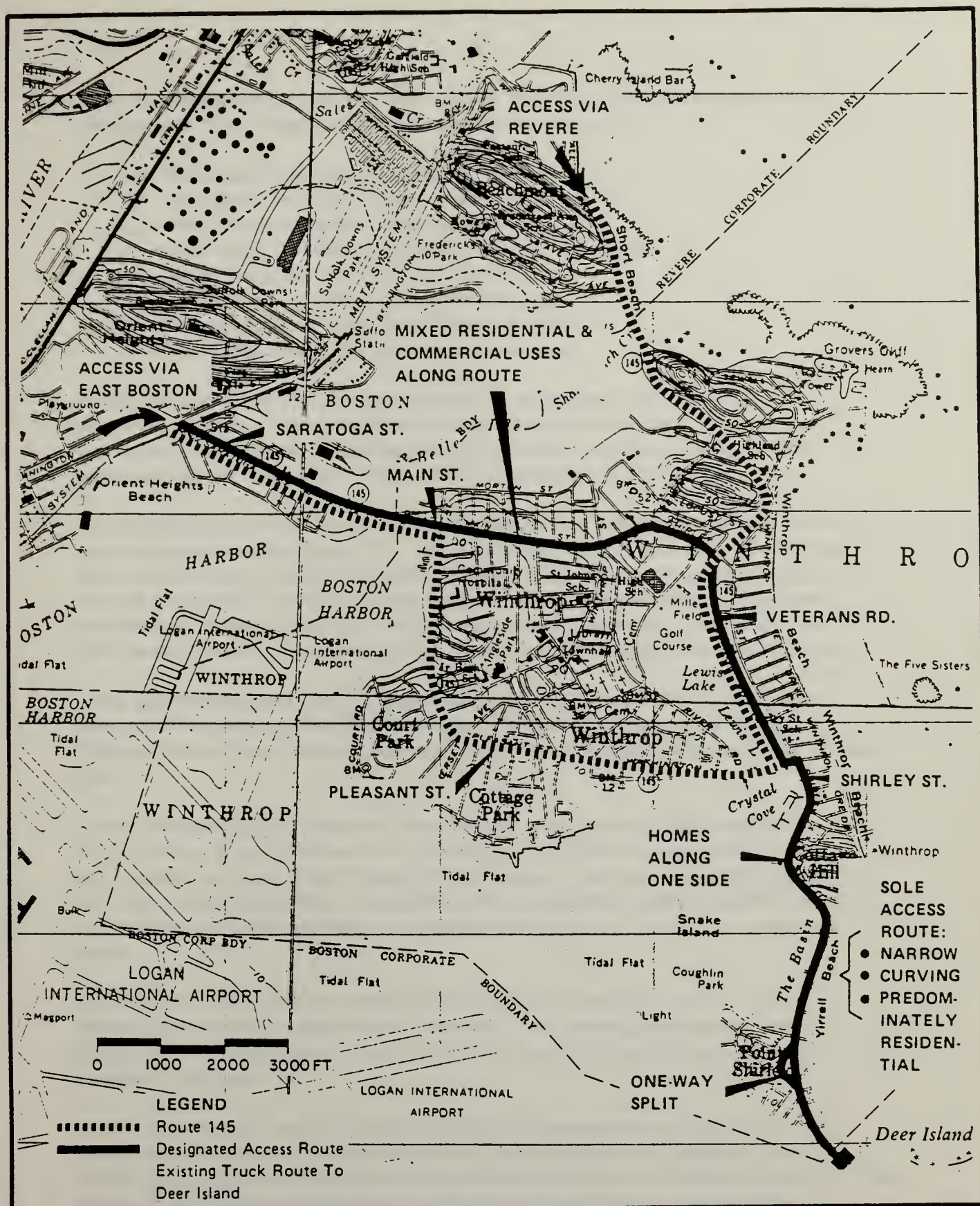
Figure K-3 presents the street network of Winthrop. A truck route has been defined and is posted, requiring that truck movements into and out of Winthrop and to Deer Island and back, use Bennington Street, Saratoga Street, Main Street, Revere Street, Shirley Street, Veterans Road, Washington Avenue, and Shirley Street. This route also avoids passage through the town center. Current truck movements over the defined route often occur with police escort.

Restrictions affecting use of the truck route include load limits on the bridge carrying Saratoga Street over the MBTA Blue Line. The bridge is currently limited to two-axle trucks that are 13 tons or less, three-axle trucks that are 20 tons or less, and five-axle trucks that are 33 tons or less.

Curbside parking is allowed along Main Street, Revere Street, Shirley Street, and the lower section of Shirley Street. The entire truck route supports two-way traffic flow; no one-way routing has been used to achieve higher throughput.

Local roadways elsewhere in Winthrop are fairly narrow, and there are no restrictions on curbside parking. Observed vehicular movements are dispersed and irregular. Only rarely is traffic movement delayed while a moving vehicle enters the opposing lane to avoid a parked vehicle occupying the moving lane.

Observations of general traffic conditions in Winthrop have shown that vehicular speeds in Winthrop are between 20 and 30 mph and appear to be a matter of local habit and preference rather than a result of deliberate enforcement policies. Observed speeds over the entire truck route are moderate, serving to reduce congestion and preserve safety along the route.



MASSACHUSETTS WATER RESOURCES AUTHORITY

FIGURE K-3

ACCESS ROADWAYS TO DEER ISLAND

Eight intersections along the current truck route that would be affected by truck movements to and from Deer Island have been identified. These intersections are:

- Bennington Street and Saratoga Street - phased signal
- Main Street and Pleasant Street - phased signal
- Main Street and Hermon Street - phased signal
- Main Street, Revere Street, Winthrop Street - blinking signal
- Revere Street and Shirley Street - blinking signal
- Shirley Street and Veterans Road - blinking signal
- Veterans Road and Washington Avenue - no signal
- Washington Avenue and Shirley Street - no signal

An alternative truck route has also been identified for use in support of Deer Island construction activities. Use of the alternative truck route would avoid the axle load restrictions of the Belle Isle Inlet bridge crossing and possible problems posed by curbside parking along Main Street, Revere Street, and the upper portion of Shirley Street.

The alternative truck route would have vehicles bound for Deer Island enter and leave Winthrop over the northern portion of Route 145. The specific local streets to be used would be Revere Street, Crest Avenue, Winthrop Shore Drive, Veterans Road, Washington Avenue, and Shirley Street to Deer Island. This route is more direct and requires less penetration of established residential and commercial development in Winthrop. It also has the advantage of somewhat wider street cartways and fewer heavily-used intersections than the truck route now being used.

Using the alternative route, trucks could gain access to major arteries north of Winthrop in Revere while avoiding the Belle Isle Inlet bridge. The route would take trucks leaving Winthrop north on Route 145 to a rotary that accesses the Revere Beach Parkway (Route 16) going south.

Trucks must currently exit the parkway onto Route 1A because a portion of Winthrop Shore Drive between Routes 16 and 1A is restricted by a bridge that limits trucks to weights of 3 tons or less. Instead, trucks could take 1A north through a rotary to the Revere Beach Parkway (Route 16) south and thus access major throughroads while bypassing the congested Sumner Tunnel and the restrictions of the two previously mentioned bridges. Figure K-3 shows the existing truck route.

One difficulty with the alternative route is that the Route 145 connection to Ocean Avenue in Revere is not completely open to trucks. The last 0.7 mile providing access to the Revere Beach rotary is currently closed to trucks. The route may not be used by trucks unless this restriction is mitigated.

For the above reason, some of the earlier transportation assessments have suggested that truck movements be turned at the southern limits of this restricted section onto Winthrop Avenue in Revere, for movement to Bennington Street at the Beachmont Station of the MBTA Blue Line. This solution is not considered desirable because Winthrop Avenue traverses a densely settled

residential area with narrow cartways, curbside parking, steep gradients, and indirect access to Bennington Street at the west end because of one-way traffic routing.

Five intersections in Winthrop along the proposed alternative truck route would be affected by truck movements to and from the Deer Island construction site. These are:

- o Crest Avenue and Revere Street - blinking signal
- o Veterans Road and Winthrop Shore Drive - no signal
- o Veterans Road and Shirley Street - blinking signal
- o Veterans Road and Washington Avenue - no signal*
- o Washington Avenue and Veterans Road - no signal*

* Intersection is also included in the existing truck route.

Observations of the affected ten intersections in Winthrop showed that significant queues do not develop, with the exception of the two intersections along Main Street that have phased signal control. These were at Hermon Street and Pleasant Street. Elsewhere, queues of no more than six vehicles are the rule, and all of these rapidly clear the intersection crossings.

During peak periods, queues accumulated at the approach stop lines were dissipated within the available green intervals in all cases except one. The left turn out of Pleasant Street onto Main Street westbound did not clear in the morning peak 20 minutes.

Peak conditions have a very short duration in Winthrop. Observations have shown that the peak hour in the morning can reasonably be identified as between 6:30 and 7:30 a.m.; however, peak conditions really exist only during the 20 minutes between 6:50 and 7:10 a.m. The same is true in the afternoon. The peak hour lasts from 5:00 to 6:00 p.m., although truly peak conditions extend over only 20 minutes between 5:20 and 5:40 p.m.

2.3 METHOD OF ANALYSIS

The volume of traffic that can pass over a given roadway is largely a function of the speed at which traffic moves. Given normal driver reaction, speeds decline as traffic volume increases; maximum throughput usually occurs at speeds ranging from 30 to 40 mph.

Determinants of capacity vary for different types of facilities. In general, freeway capacity is a function of lane width, number of lanes provided, availability of improved shoulders and sight lines. For arterials, capabilities at intersections where conflicting movements can occur are usually the determinant of capacity. This is especially true in heavily travelled corridors. Under principles of analysis established through the work of the Highway Research Board, the maximum volume that occurs under the conditions described above is generally taken as representative of the capacity of the particular facility under examination.

The potential impact on particular intersections in Winthrop that will be affected most directly by the Deer Island construction traffic has been examined in detail to determine

whether new intersection delay could cause significant local distress. The purpose in these detailed assessments has been to identify potential changes of service level at the intersections and delay associated with queues awaiting a green signal.

To measure the performance of existing or proposed highway facilities, the ratio of projected volume to available capacity is commonly used. The numerator and the denominator of this ratio are usually measured in terms of hourly vehicular flows, and a value of unity for the ratio is accepted as an indication that traffic volume fills the available capacity of a facility. Ratios larger than unity imply traffic volume in excess of available capacity, moving under forced flow conditions at slow speeds. A ratio having a value less than unity means that volume has not yet reached capacity and the more acceptable traffic conditions prevail.

Because of the need for recognition of local traffic conditions in estimates of highway performance, the Highway Research Board, in 1965, adopted a defined series of service levels that could be used in comparative assessments of the degree to which highway facilities accommodate traffic. These Levels of Service have had wide acceptance and application since 1965.

The Highway Research Board Levels of Service represent qualitative standards of the overall ability of defined highway facilities to satisfy motorists' desires at different times of the day and in relation to various levels of average operating speed, safety, freedom of maneuver, traffic mix, and operating cost. Standard Levels of Service have been defined for limited-access facilities and for urban and rural arterials. The requirements for the several Levels of Service give recognition to the number of lanes available for travel, degree of intersection interference, lane width, and other aspects of highway geometry and control.

In general, the defined Levels of Service A, B, and C described traffic volumes that are sufficiently low to provide free and stable flow of traffic at attractive operating speeds. Service Level D usually describes a volume for given facilities that would cause unstable flow conditions to be approached, at reduced and less attractive operating speeds. Service Levels E and F usually connote excessive volumes, unstable or forced flow conditions, high levels of delay, and unattractive operating speeds.

Work has been done in recent years to relate delay at intersections to the relationship between traffic volume and available capacity, and in turn, to levels of service. The relationships developed in this work have been used in the present investigations.

Computer-based methods of analysis have been used, allowing specific consideration of the magnitude and composition of traffic flows from each approach entering an intersection. Specific 15-minute peaking relationships are recognized for each approach, and an independent assessment is made of the degree to which each approach operates with the available green time at the signal fully used to pass traffic. Estimates of capacity, the ratio of volume to capacity, service level, delay, and length of queue have been prepared for each approach at each intersection and for each intersection as a whole.

Through iterative application of the program to existing conditions and to conditions that will exist with the new plant in operation, the differential impact that will be experienced at each location as a result of the change in truck flows has been identified.

The methods used in the analysis are completely consistent with American traffic engineering practice. The details for method and data applied in each case are set forth in a description of the investigations performed for each intersection that appears later in this report.

The intersections have all been analyzed using phased signal control. In the proposed conditions, phased signalling is used as a safety measure to mitigate the estimated increase in traffic flow. In the existing condition analyses, phased signalling is used in all cases to provide a baseline for comparison with the projections made for the future.

2.4 INTERSECTION ASSESSMENTS - WINTHROP, MA

Intersection traffic volumes and turning movements were estimated whenever possible using existing traffic count data. Turning movement count data collected during previous studies for the morning and afternoon peak periods showed that the critical hour in Winthrop occurs in the afternoon peak period. Turning movement counts were available for six of the intersections; additional counts were made for the remaining four intersections. Signal phasing and intersection geometry data were obtained from the Massachusetts Department of Public Works and the Town of Winthrop.

The following computed estimates have been made for each intersection:

- Service Level for each intersection approach
- Service Level for the intersection as a whole
- Delay in vehicle-hours for each intersection approach
- Delay in vehicle-hours for the intersection as a whole
- Average queue length for each intersection approach

All estimates have been developed assuming no change of existing cartway widths, curbside parking practice, or signal phasing. In cases where the intersection is not now controlled by a phased signal, a signal with equal cycle lengths for each leg has been used for purposes of this analysis. Details pertaining to each intersection examined are discussed below.

1) Main and Pleasant Streets - HMM Associates traffic data collected on September 11, 1985 show that the peak hour at this location occurs between 5:00 and 6:00 p.m. The largest peak-hour volumes occur on the eastbound Main Street approach. The total peak-hour volume is 1,757 vehicles. The signal cycle time is 94 seconds.

2) Main, Revere, and Winthrop Streets - HMM Associates traffic data collected on September 12, 1985 show that the peak hour at this location occurs between 5:00 and 6:00 p.m. The largest peak-hour volumes occur on the eastbound Main Street and

westbound Revere Street approaches. The total peak-hour volume is 1,386 vehicles. The signal cycle time is 79 seconds.

3) Revere and Shirley Streets - PEER Consultants traffic data collected on July 10, 1987 show that the peak hour at this location occurs between 5:00 and 6:00 p.m. The largest peak-hour volumes occur on the eastbound Revere Street approach. The total peak-hour volume is 1,392 vehicles. The signal cycle time is 68 seconds. This intersection is currently controlled by blinking lights. Movements on Revere Street in both directions are controlled by yellow flashers, and movements on Shirley Street are controlled by a red flasher.

4) Shirley and Veterans Road - HMM Associates traffic data collected on September 11, 1985 show that the peak hour at this location occurs between 5:00 and 6:00 p.m. The largest peak-hour volumes occur on the eastbound Shirley Street approach. The total peak-hour volume is 605 vehicles. The intersection is currently controlled by a blinker with no provision for phased signaling.

5) Veterans Road and Washington Avenue - HMM Associates traffic data collected on September 12, 1985 show that the peak hour at this location occurs between 5:00 and 6:00 p.m. The largest peak-hour volumes occur on the eastbound and westbound Washington Street approaches. The total peak-hour volume is 796 vehicles. The intersection is currently controlled by a stop sign.

6) Washington Avenue and Shirley Street - HMM Associates traffic data collected on September 11, 1987 show that the peak hour at this location occurs between 5:00 and 6:00 p.m. The largest peak-hour volumes occur on the eastbound Washington Street and northbound Shirley Street approaches. The total peak-hour volume is 823 vehicles. The intersection is currently controlled by a stop sign.

7) Veterans Road and Winthrop Shore Drive - PEER Consultants traffic data collected on July 8, 1987 show that the peak hour at this location occurs between 4:30 and 5:30 p.m. The largest peak-hour volumes occur on the southbound Winthrop Shore Drive approach. The total peak-hour volume is 761 vehicles. The intersection is currently uncontrolled.

8) Revere Street, Crest Avenue, and Highland Avenue - PEER CONSULTANTS traffic data collected on July 9, 1987 show that the peak hour at this location occurs between 4:45 and 5:45 p.m. The largest peak-hour volumes occur on the southbound Revere Street approach. The total peak-hour volume is 1,592 vehicles. The intersection is currently controlled by a blinking yellow and red flasher with no provision for phased signaling.

9) Bennington Street and Saratoga Avenue - HMM Associates traffic data collected on October 1, 1985 show that the peak hour at this location occurs between 5:00 and 6:00

p.m. The largest peak-hour volumes occur on the northbound Bennington Street and westbound Saratoga Street approaches. The total peak-hour volume is 2,250 vehicles. The signal cycle time is 113 seconds.

Each intersection has been examined under worst-case conditions regarding the need for daily truck movement in support of current operations on Deer Island and proposed construction activities. These conditions have included recognition of all the peak-to-base relationships plus the following:

1) Changes of truck and automobile volume caused by the Deer Island construction activities will occur on particular legs of the intersection.

2) Where the potential exists for truck and automobile movements to involve right or left turns through the intersection, the worst-case movements are used in the analysis.

3) Most truck movements will occur outside commutation peak hours and will be spread through the course of the day. The maximum volume of trucks that will move through the intersection during any hour is 24. The 24 trucks correspond to an upper volume limit described earlier in this report. This truck volume has been applied to the peak hour under the assumption that if conditions do not change significantly during this worst-case assumption, normal truck movements will have no affect on the intersection.

4) It is estimated that a maximum of 65 additional automobiles will move through an intersection during the peak hour because of construction activities.

5) Intersections not currently controlled by phased signaling have been analyzed with signal control. Those intersections with the current capability of phased control have been analyzed using the information contained on the phasing permit. Intersections that require installation of phased signals have been analyzed using an 80-second signal cycle with the green time equally apportioned among all legs of the intersection.

The intersections have been analyzed for both existing and future service level conditions. The existing condition analysis established a baseline for measuring whether additional traffic volumes moving through an intersection will affect current intersection performance.

Table K-2 summarizes the existing condition Service Levels. The table shows the intersection peak traffic volumes, effective capacity, signal time, estimated overall Service Level, and computed average delay for each intersection under existing conditions. In all cases, the Overall Service Level is A.

TABLE K-2

EXISTING CONDITION SERVICE LEVELS

Intersection	Peakhour volume	Effective capacity	Cycle time (sec)	Overall service level	Avg delay per vhcl (sec)
Bennington & Saratoga	2,250	4,799	113	A	18
Main & Pleasant	1,757	5,601	94	A	7
Main, Revere, & Winthrop	1,386	2,631	79	A	19
Revere & Shirley	1,392	3,116	68	A	11
Veterans & Shirley	605	3,628	80	A	6
Veterans & Washington	796	4,456	80	A	2
Washington & Shirley	823	3,915	80	A	3
Veterans & Winthrop Shr	761	3,506	80	A	4
Crest, Revere, & Highland	1,592	3,677	80	A	14

Table K-3 summarizes the future condition Service Levels using the worst-case condition that all trucks are moving in one direction: toward Deer Island. The table shows the intersection peak traffic volumes, effective capacity, signal cycle time, estimated overall Service Level, and computed average delay for each intersection under existing conditions. In all cases, the overall Service Level is A.

TABLE K-3

FUTURE CONDITION SERVICE LEVELS
TRUCK MOVEMENTS TO DEER ISLAND

Intersection	Peakhour volume	Effective capacity	Cycle time (sec)	Overall service level	Avg delay per vhcl (sec)
Bennington & Saratoga	2,273	4,768	113	A	19
Main & Pleasant	1,806	5,539	94	A	7
Main, Revere, & Winthrop	1,474	2,517	79	A	24
Revere & Shirley	1,416	3,023	68	A	11
Veterans & Shirley	629	3,587	80	A	8
Veterans & Washington	820	4,321	80	A	3
Washington & Shirley	848	3,825	80	A	3
Veterans & Winthrop Shr	785	3,429	80	A	5
Crest, Revere, & Highland	1,616	3,650	80	A	14

Table K-4 summarizes the future condition Service Levels using the worst-case condition that all trucks are moving in one direction: away from Deer Island. The table shows the intersection peak traffic volumes, effective capacity, signal cycle time, estimated overall Service Level, and computed average delay for each intersection under existing conditions. In all cases, the overall Service Level is A.

TABLE K-4

FUTURE CONDITION SERVICE LEVELS
TRUCK MOVEMENTS FROM DEER ISLAND

Intersection	Peakhour volume	Effective capacity	Cycle time (sec)	Overall service level	Avg delay per vhcl (sec)
Bennington & Saratoga	2,340	4,724	113	A	19
Main & Pleasant	1,845	5,476	94	A	7
Main, Revere, & Winthrop	1,410	2,581	79	A	22
Revere & Shirley	1,480	3,060	68	A	13
Veterans & Shirley	693	3,502	80	A	6
Veterans & Washington	884	4,190	80	A	3
Washington & Shirley	911	3,852	80	A	5
Veterans & Winthrop Shr	849	3,326	80	A	4
Crest, Revere, & Highland	1,704	3,632	80	A	17

Copies of computer printouts for the Winthrop intersection analysis are attached at the end of this appendix.

3.0 SECONDARY TREATMENT FACILITIES TRANSPORTATION IMPACTS

3.1 INTRODUCTION

This section addresses transportation impacts associated with the construction of preliminary, primary, and secondary treatment and support facilities for a new 500 million gallon per day (mgd) plant that will be built to provide treatment of wastewater for the Boston Metropolitan area. The new plant will be located on Deer Island. Companion reports address traffic impacts that will result from construction of the following related improvements:

1) Volume IV - Inter-Island Conveyance System

2) Volume V - Effluent Outfall

3) Volume VI - Early Site Preparation

The cumulative traffic impacts of the recommended Secondary Treatment Facilities Plan are summarized in Section 11.4.4 of Volume III - Treatment Plant. The recommended facilities defined for the treatment facilities are detailed in Section 11.0 of volume III.

Transportation requirements to Deer Island and Nut Island for construction of the facilities include initial transport of construction equipment, periodic transport of materials to and from the Islands, and daily transport of workers to and from the sites during all phases of construction. All of this represents traffic between the mainland and the island plant sites that must be added to existing movements.

Both islands are linked to the mainland. Deer Island is connected by a causeway reached by passing over local roads through the Town of Winthrop. Nut Island, located at the tip of a land mass that is part of the mainland, is reached by passing over local roads through the City of Quincy. Nut Island traffic may also travel over local roads in Braintree and Weymouth to reach Quincy from the arterial highway network.

The sections that follow describe the facility construction sequence and estimated daily worker and truck trip volumes that could result from the construction. The discussion begins, however, with a summary of findings.

3.2 FINDINGS

Treatment facilities construction will occur between 1991 and 1999. The estimated daily construction worker requirements range from 155 to 875. Peak worker needs occur in 1992 and 1993 during primary treatment facilities construction, and in 1996 and 1997 during secondary treatment and aeration facilities construction. Worker requirements are at least 50 percent less than the peak in 1991, 1994, 1998 and 1999, and about 30 percent less in 1995.

At least one-half of the construction workers will be ferried over water from existing ferry facilities to Deer Island; the other half may be bussed overland to Deer Island through Winthrop, from satellite parking facilities on the mainland. Most equipment and material movement to the Islands will be over water by barge using the newly constructed on-shore piers or other remote docking facilities. Communities potentially affected by these construction traffic movements have been addressed in previous reports to the Massachusetts Water Resources Authority (MWRA).

Estimated daily truck trip volumes to the on-shore piers range from 20 to 170. The highest trip volumes are generated from 1992 through 1993 and from 1996 through 1997 and are a direct result of facility construction schedule overlaps. Daily truck trip volumes are at least 25 percent less than the peak in 1995, at least 40 percent less in 1994 and 1998, and more than 50 percent less in 1991 and 1999.

It is possible that some or all of the cement, sand and gravel needed for concrete mixing will be loaded onto barges at docking facilities close to supply sources for direct transport over water to Deer Island and Nut Island, greatly reducing possible truck trip volumes to the newly constructed on-shore pier facilities. Daily truck trip volumes could be decreased by as much as 40 percent if one-half of the concrete material requirements are delivered to the Islands from remote mainland docking facilities. Estimated daily truck trip volumes would then range from 15 to 135.

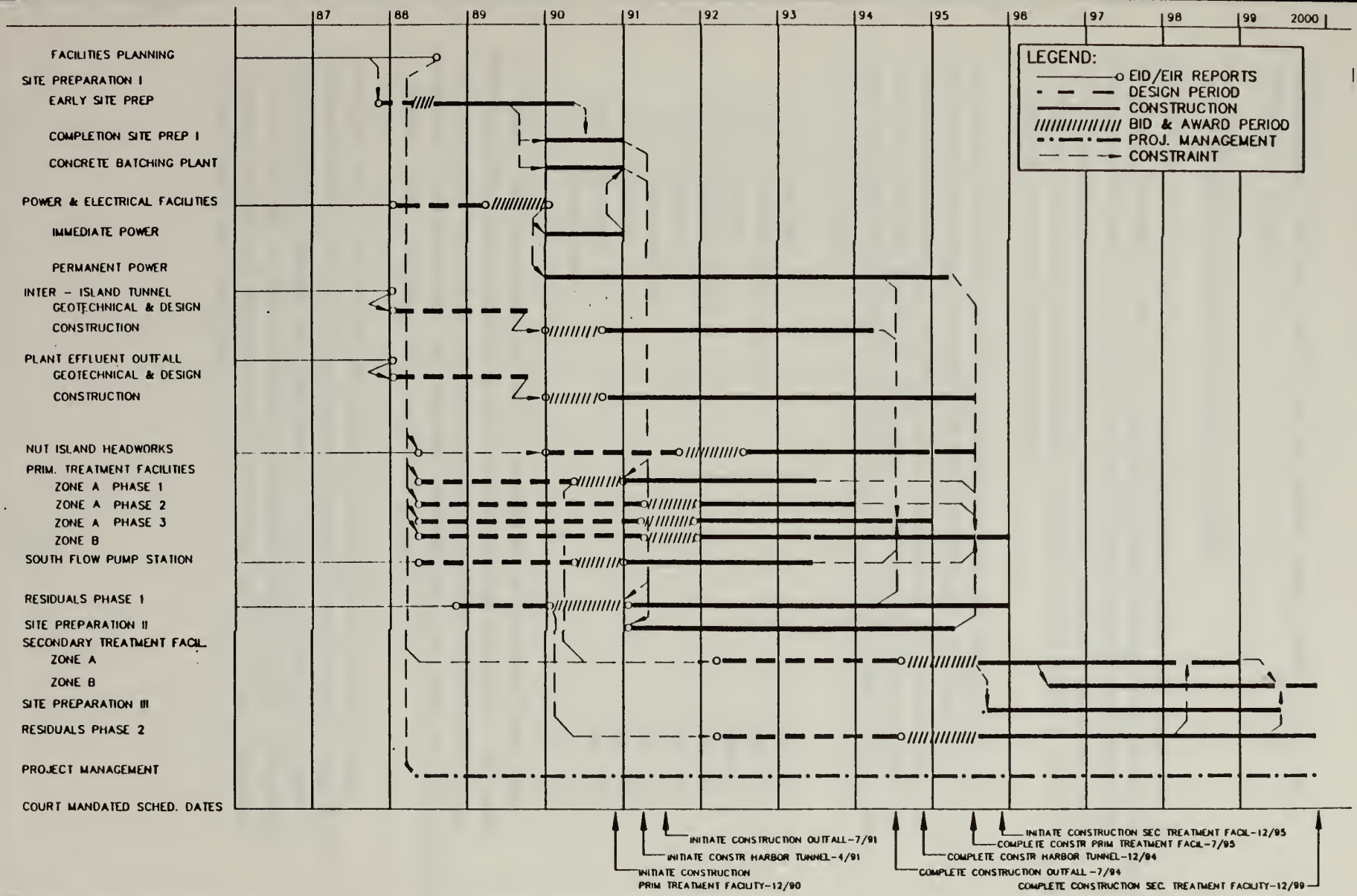
3.3 FACILITY CONSTRUCTION SEQUENCE

Figure K-4 shows the construction schedules for the various treatment facilities as of October 1987.

It is expected that the on-island and on-shore pier facilities construction will be complete and in operation by the end of 1989 for use in delivering construction equipment and material over water to the island. Construction material and equipment water transport to and from Deer Island will be by barge using the newly constructed piers. The equipment and material, however, must first be transported overland to the mainland pier facilities. It is possible that the material will be trucked to the on-shore pier facilities if rail transport is not available. Communities surrounding the piers thus could be affected by construction truck traffic.

Material transport overland to the newly constructed on-shore pier facilities may be mitigated by overwater delivery of materials to the island from remote mainland locations. Material could be loaded onto barges at docking facilities that are located close to supply sources.

Construction worker transport to Deer Island will be over water using ferries from existing on-shore facilities and over land using buses that will travel between Deer Island and mainland satellite parking facilities. Worker ferry transport has been addressed in the reports



MASSACHUSETTS WATER RESOURCES AUTHORITY

FIGURE K-4
SUMMARY OF PROJECT CONSTRUCTION SCHEDULE

discussed above. Bussing workers to and from satellite parking facilities is discussed in Section 4.0 of this appendix.

3.4 ESTIMATED WORKER AND TRUCK VOLUMES

A method has been developed for use in quantifying potential worker and truck trip volumes in the absence of detailed worker-hour, material quantity and equipment requirement information. Truck movements and work force needs have been estimated using available data on total construction costs for the proposed facilities. Refinements to the truck and worker volume estimates may be neccesary when more specific information becomes available. The criteria used in developing the estimates are described below.

The required construction for the various facilities can be divided into eleven general components. Two of these components, earthwork and sitework, will comprise almost all of the site preparation construction. All other facility construction will also include some or all of the nine components listed below. Component construction will occur at specific time periods during the overall facility construction duration. The components and associated time periods are listed below.

1)	Concrete	First 2/3
2)	Mechanical Equipment	Last 1/2
3)	Masonry	Middle 1/3
4)	Steel and metals	Last 1/2
5)	Electrical	Last 1/2
6)	Instrumentation	Last 1/3
7)	HVAC	Last 1/2
8)	Plumbing	Last 1/2
9)	Finish work	Last 1/4

Percentages of total construction costs can be estimated for the components listed above. These cost percentages vary depending on the facility type under construction. The overall cost for each component can then be apportioned into equipment, labor and material cost percentages. These apportioned cost percentages also vary among the components. Quantity can be assigned to each component, and a cost per unit estimated.

Dividing the cost per unit into the total component cost provides an estimate of overall component material quantity. An assessment of the quantity a truck can carry is then made so that total hauls per component can be estimated. Dividing the total hauls by component construction duration provides an estimate of the component daily truck trips. Summing the component truck trips and subtracting separate trip timings provides an overall estimate of daily facility construction truck trips.

A daily worker estimate can be developed in the same manner. The component cost specific to labor is determined from the estimated component labor cost percentage, and the cost associated with fringe benefits is subtracted from the overall labor cost to establish the no-fringe payroll cost. The no-fringe payroll cost is then divided by the component construction duration to establish the per-day no fringe payroll cost.

A daily worker wage for each component is assigned. The wage is then divided into the per-day payroll cost so that a component construction daily worker requirement can be estimated. The facility component worker requirements are summed, and separate construction timings are subtracted.

Table K-5 summarizes the estimated daily worker and truck volumes for each construction category. The highest worker and truck trip requirements are for site preparation 2, primary treatment, secondary treatment and aeration facilities construction. The high truck trip volumes are the result of removing 730,000 cubic yards of excavated material in 22 cubic-yard trucks over a four year period and delivery of concrete materials throughout the construction period. It is estimated that approximately 590,000 cubic yards of concrete will be placed. It has been assumed conservatively for purposes of these estimates that the removal of excavated spoil and delivery of concrete materials by truck will be necessary.

Construction schedule overlaps occur among the various facility construction categories. The primary treatment facility construction overlaps with the administration building, Winthrop terminal and Nut Island headworks work and site preparation 2 work. The secondary facilities, aeration facilities, maintenance facilities and site preparation 2 and 3 activities occur during the same time period. Table K-5 also shows the average and peak daily workers and truck trips that will occur each year during construction of the facilities.

The largest daily worker and truck trip volumes occur from 1992 through 1993 and 1995 through 1997 and are a direct result of construction schedule overlaps among site preparation 2 and primary treatment facilities work and secondary treatment facilities and aeration facilities work.

3.5 SIMULTANEOUS CONSTRUCTION PROJECTS

The above section describes only the estimated daily truck and worker volumes that could be generated from treatment facility construction on Deer Island and Nut Island. Other construction will occur on Deer island during the same period. Site preparation 2, primary treatment facilities, administration building, Nut Island headworks and Winthrop Terminal construction coincide with influent inter-island conduit and effluent outfall conduit work. The secondary treatment and aeration facilities work could overlap with effluent outfall construction depending on the outfall option selected.

TABLE K-5
ESTIMATED FACILITY DAILY WORKER AND TRUCK VOLUMES

FACILITY	WORKERS AVERAGE	WORKERS PEAK	TRUCKS TO PIERS AVERAGE	TRUCKS TO PIERS PEAK	TRUCKS TO PIERS LESS 50% CONCRETE AVERAGE	TRUCKS TO PIERS LESS 50% CONCRETE PEAK	TRUCKS TO PIERS PERCENT DECREASE AVERAGE	TRUCKS TO PIERS PERCENT DECREASE PEAK
Site Preparation 2	100	130	35	35	35	35	0%	0%
Primary Treatment								
Train A	155	205	20	40	15	25	25%	38%
Train B	155	205	20	40	15	25	25%	38%
Secondary Treatment								
Train A	220	290	30	50	15	30	50%	40%
Train B	220	290	30	50	15	30	50%	40%
Aeration Facilities								
Train A	75	95	10	20	10	15	0%	25%
Train B	75	95	10	20	10	15	0%	25%
Administration Building	20	25	5	5	5	5	0%	0%
Maintenance Facility	55	75	5	10	5	10	0%	0%
Nut Island Headworks	55	70	10	20	10	20	0%	0%
Winthrop Terminal	65	85	20	40	15	25	25%	38%
Site Preparation 3	25	30	10	20	10	20	0%	0%

TABLE K-5
ESTIMATED FACILITY DAILY WORKER AND TRUCK VOLUMES
(continued)

YEAR	WORKERS AVERAGE	WORKERS PEAK	TRUCKS TO PIERS AVERAGE	TRUCKS TO PIERS PEAK	TRUCKS TO PIERS LESS 50% CONCRETE AVERAGE	TRUCKS TO PIERS LESS 50% CONCRETE PEAK	TRUCKS TO PIERS PERCENT DECREASE AVERAGE	TRUCKS TO PIERS PERCENT DECREASE PEAK
1991	155	205	20	40	15	25	25%	38%
1992-1993	550	720	110	180	95	135	14%	25%
1994	310	405	65	95	60	80	8%	16%
1995	450	585	85	125	70	100	18%	20%
1996-1997	670	875	95	170	65	120	32%	29%
1998	320	415	50	90	35	65	30%	28%
1999	245	320	40	70	25	50	38%	29%

Construction of the influent conduit will occur between January 1991 and December 1994. Effluent outfall construction will begin in June 1990 and end in June 1994 for the four-mile option; or end in December 1995 for the ten-mile option. Aggregate truck and worker volumes that could result because of construction schedule overlaps among treatment facilities, influent conduit and effluent conduit construction have not been examined.

3.6 SOUTH SHORE TRAFFIC IMPACTS

Construction traffic impacts to Quincy and surrounding communities have been addressed by others in studies for the Massachusetts Water Resources Authority (MWRA). The potential traffic impacts in these communities associated with the treatment facility construction described above have not been examined here and are not discussed in this report.

3.7 WINTHROP TRAFFIC IMPACTS

Winthrop traffic impacts resulting from construction, automobile and truck traffic have been examined in Section 2 of this appendix. Traffic impact intersection analyses were performed using additional truck and automobile worse cast estimates of 190 trucks and 400 automobiles per day. These analyses showed that overall levels of service did not decrease when construction vehicles were added to existing traffic.

4.0 CONSTRUCTION WORKERS SATELLITE PARKING ASSESSMENTS

4.1 INTRODUCTION

This section summarizes satellite parking transport feasibility assessments for movement of construction workers between Deer Island and satellite parking facilities.

Deer Island is connected to the mainland by a causeway. The causeway is accessed by passing over local roads through the Town of Winthrop. The Island will also be accessible by water once the new on-island pier facilities are constructed and in operation by the end of 1989. Construction worker transport over water by ferry has been addressed in previous reports to the Massachusetts Water Resources Authority. Analysis of traffic issues and potential impacts to communities resulting from movements of workers to and from Deer Island over water are not examined here.

Since not all workers may conveniently have access to the ferry loading areas, some of the workers required at Deer Island may still need access over the land route through Winthrop. The Authority may be required to provide an alternate capability that will be complementary to the use of ferry operations for many of the workers, and not a substitute for the overwater alternative.

For purposes of analysis and impact assessment, it has been assumed here that as much as half of the total construction work force required at Deer Island may seek access by land. For the most part, these workers will be coming to the worksite from residential locations in the eastern, northern and northwestern parts of the Metropolitan Boston region.

Since earlier investigations have indicated that an arrangement allowing unrestricted access to Deer Island by automobile would give rise to unacceptable traffic management problems in Winthrop, the workers seeking access by land will have to do so by traveling to satellite parking areas by automobile or other means, for transfer and delivery to the worksite by bus.

Several options are available to employ this concept. The one that now appears most attractive would be to extend the operating authority of the bus company currently serving Winthrop to allow scheduled vehicles to service parking facilities that would be developed at locations along, or near, the MBTA Blue Line through East Boston and nearby communities. Opportunities for developing appropriate parking and transfer facilities at locations along this corridor are discussed in the report that follows.

4.2 RECOMMENDATIONS

Parking for approximately one-half of the total Deer Island work force could be accomodated by linking three satellite parking facilities to the Deer Island work site by bus. The three facilities are located along or near the MBTA Blue Line, at the Orient Heights Blue Line

Station, the Suffolk Downs Race Track, and the Metropolitan Development Commission (MDC) lot north of Wonderland.

Satellite parking at these locations could provide a combined capacity of approximately 650 parking spaces for worker vehicles, in close proximity to each other as well as to the Deer Island work site. All three sites are accessible by automobile and by public transit. Placing bus stops at these three sites gives workers flexibility to choose where they will park and how they will get to the satellite facilities.

The Orient Heights MBTA Blue Line station, located in East Boston, has parking facilities northeast of the intersection of Bennington and Saratoga Streets. These facilities currently serve Blue Line commuters and are filled to capacity each day. The lot can be improved to provide an additional 50 parking spaces. Most workers using the Blue Line to commute to satellite facilities would disembark at this location. Providing bus service to Deer Island at this location will mainly serve workers able to use public transport for movement to and from the construction work site.

The Suffolk Downs Race Track is located south of Winthrop Avenue in Revere and can be reached from the Suffolk Downs and Beachmont MBTA Blue Line Stations. The race track has a capacity of approximately 1,200 parking spaces, at least one-fourth of which could be available for Deer Island worker parking.

The Metropolitan District Commission (MDC) parking lot is located on Ocean Avenue south of Revere Street and is just north of the eastern portion of the Wonderland MBTA parking facility that currently serves Blue Line commuters. The MDC lot can be marked to hold approximately 600 parking spaces. One-half could be available for Deer Island worker vehicles without reducing the space currently used by other commuters.

It is expected that most workers will travel to the satellite areas by automobile with only a small percentage using public transit for commuting. Intersections in the vicinity of the three sites that could be affected by the additional construction worker automobile traffic have been identified. These intersections have been analyzed to determine existing levels of service and to ascertain whether the increased construction traffic would reduce these service levels. In all cases, service levels remain unaffected by the construction traffic addition.

Bus service to the three sites would occur along two routes with no more than one bus per stop at any one time. Currently, the Orient Heights Station is served by Rapid Transit Service, Inc. of Winthrop. Authority for this existing bus service which runs from the Orient Heights Station through Winthrop could be extended to service Deer Island.

Route 1 would provide service between the Island and Orient Heights Station, and Route 2 would provide service between the Island, Suffolk Downs Race Track and the MDC Lot. Total round trip distances are 9 miles and 10.5 miles respectively. Approximately three Route 1 buses and four Route 2 buses, traveling at 15 mph average speeds and at 15-minute scheduled service intervals,

are required to transport workers during peak shift change periods. The average one-way travel time between Deer Island and a satellite facility will not exceed 30 minutes.

Costs for developing and operating the satellite parking areas are relatively modest since planned use would not depart from current use. At most, paving and striping of lots, and establishment of bus stop areas are needed. Lot attendants are required to assure that unauthorized vehicles are not parked in spaces reserved for workers, and to assure that parked vehicles are not vandalized. Estimated development costs for the three areas is $1.3 million, and estimated annual security costs are $285,000.

The Orient Heights Station and MDC Lot managements charge a daily fee of $1.00 for parking and provide security surveillance of the lots. Parking at the race track is free and minimal security is provided. It is expected that arrangements for use of the three lots could be worked out with current management, since facility improvements would be initiated by the Authority and the planned site use is an extension of current and projected use.

Bus service costs include vehicle operation and maintenance. A cost-per-worker-trip would be established and the bus service company would receive recompense based on worker service use. Costs for transporting workers by bus daily between Deer Island and the satellite facilities would be recouped through the aggregate worker-trip fares generated.

Permanent satellite parking facilites are required to accomodate approximately 300 plant administrative and operations and maintenance workers each day. The Suffolk Downs Race Track and MDC Lot both have space available to support these parking requirements. Either one or both lots could be used as a parking facility provided suitable arrengements for permanent use of the sites could be worked out with current management. Lot operation would be similar to the temporary construction worker parking plan described here. The construction workers bus service plan could also be revised to provide scheduled service for permanent Plant personnel.

4.3 METHOD OF ANALYSIS

To examine options available to the Authority for development and use of satellite parking facilities that would support daily transfer of a significant portion of the construction work force needed at the Deer Island worksite, a relatively formal method of assessment has been applied. The steps involved have included:

1) Preliminary identification of potential parking sites having reasonable proximity to Deer Island that could potentially be used to satisfy Authority purposes during the intended construction period.

2) Elaboration of a specific set of screening criteria for use in evaluating the candidate parking sites.

3) Application of these criteria to identify a specific set of locations that would most likely fit the Authority's purposes, with minimal advserse effect on other aspects of

daily commutation in the Boston Metropolitan region.

4) Detailed assessment of requirements at the better candidate locations for satellite parking, considering possible arrangements for use of existing facilities, requirements for physical improvement of facilities, public transport access, existing traffic conditions, Deer Island construction traffic flows and potential transportation impacts.

5) Definition of a bus service operating plan capable of handling the worker movements between satellite parking facilities and Deer Island, without unacceptable impact on street traffic in Winthrop or public transport service along the MBTA Blue Line.

6) Analysis of traffic flows and performance at intersections that may be critically affected by daily movements to and from the satellite parking facilities, to assess potential impacts and identify desirable mitigation actions.

7) Estimation of costs that would be involved in the development of appropriate facilities, their operation to accommodate Deer Island construction workers, and the operation of public transport service to provide connection between the satellite parking facilities and the worksite at Deer Island.

8) Comparative evaluation of relative costs and advantage for the Authority, and identification of potential cost-sharing arrangements.

A first requirement, and a key feature in this methodology, concerns the explicit definition of criteria used for the initial screening evaluations. These are discussed in the paragraphs that follow.

4.4 SCREENING CRITERIA

Twelve general criteria have been used for the purpose of screening candidate sites that might be acceptable for use as locations for satellite parking where Deer Island workers would leave automobiles during work shifts for transfer to and from the worksite on Deer Island by bus. The 12 criteria include:

1) Ease of general access by automobile and public transport service.

2) Proximity to the Deer Island worksite.

3) Presence and availability of existing parking facilities.

4) Ease of prospective arrangements for use by Deer Island construction workers.

5) Ease of parking facility improvements, if needed.

6) Ease of providing security for parked vehicles.

7) Degree of compatibility with nearby land uses, both existing and planned.

8) Degree of public controversy that may attach to use of space by Deer Island construction workers.

9) Ease of access to and from Deer Island by transfer bus.

10) Relative prospective efficiency of transfer bus service operations.

11) Severity of prospective transportation impacts and ease of mitigation.

12) Approximate costs of the development and use of parking facilities and related transfer bus services.

Each of these criteria for evaluation and assessment is described briefly in the paragraphs that follow. The order of exposition is not intended to suggest relative priority. The criteria have been used to address the issues related to each prospective site. Each prospective site has been considered on its own merits, for the purpose of identifying a reasonable set of alternatives for providing a level of service that would allow as many as half of the construction workers needed at Deer Island to reach the worksite daily through the satellite parking facilities and the transfer bus services.

A first requirement is that a satellite parking location be accessible by automobile. This means that the site must be within relatively easy reach of major highway facilities serving the Metropolitan Boston region, and that the local arterial and street connections provide access for entry to and egress from the proposed parking spaces without complicating existing conditions of traffic flow on local streets. Because there is an advantage in spreading the prospective traffic load, this criterion concerning ease of access also suggests that some desirability may lie in providing more than one location where satellite parking and transfer bus services would be provided.

In addition to the potential problems for the local street network, the ease of access criterion also extends to the degree to which a selected site for satellite parking may also be accessible for workers who would commute to and from the Deer Island site using the MBTA public transport services. There may only be a few such workers, but the presence of the MBTA Blue Line in the corridor providing access to Deer Island means that the parking facilities should also be developed in relatively close proximity to the MBTA stations if possible. Workers using this means of transport to the construction site would be moving generally in a direction opposite to normal peak flows on the rapid transit system, and may be able to travel to and from the construction worksite on Deer Island at nearly minimal cost to themselves and others.

A second criterion of some importance concerns proximity to the Deer Island construction site

itself. The requirement here is that the time needed for transfer trips between the parking lots and the worksite itself be minimized. This is desirable to avoid delay and lost time for workers as well as to restrain the cost associated with the transfer movement. Proximity to Deer Island can be considered in several ways. Of interest is the matter of distance between the satellite parking facility and Deer Island, as well as available street access and the degree of circuity that may be required in bus service operations. Additionally, obtainable speeds in bus service are relevant to minimize the time needed for transfer movements. The questions of proximity to Deer Island have been examined in terms of the time that would be required for movement of construction workers to and from the site.

Where parking facilities may already exist at some candidate locations, this presents a distinct advantage. Of interest in such situations is a series of questions regarding the number of parking spaces present, the timing and intensity of their use, the degree to which existing spaces may be available for use by construction workers, and the degree to which the purposes that construction worker use would serve may conflict with the timing of other, established demand for use of the space. Wherever complementary use involving the construction workers might be achieved, the possibilities for purposes of the Deer Island construction project are improved.

In addition to the matter of whether or not existing facilities may be present and available for use, more general considerations regarding ownership and control of existing parking facilities or available plots of land must be considered. These issues have been examined on a general basis without approaching current owners or initiating discussions concerning specific arrangements that might be made for use of existing facilities or land to support satellite parking for the Deer Island construction project. Nonetheless, the matter of general availability and probable ease of securing such arrangements has been considered along with the other criteria discussed in these paragraphs.

Related to the questions of access to land and facilities for such use is the matter of possible requirements or options for improvement of land, or of existing parking facilities, to support use by the Deer Island construction workers. Options that may be available for expansion of existing facilities, or for their restoration and improvement, have been considered as potentially desirable steps, along with the relative degree of difficulty that may be involved in accomplishing them.

In similar fashion, the ease or difficulty that may reside in providing sufficient security for workers and the automobiles that they would leave at the satellite parking locations has been considered. Where arrangements may already exist for basic security of parked vehicles, these have been identified and noted as suggesting a relatively easy solution to the security requirement that must be satisfied in order to persuade Deer Island workers to use the satellite parking and transfer bus arrangements. Where existing arrangements may not already be present, the need to provide them has been considered. In either case, the costs associated with providing sufficient security have been recognized in the quantitative assessments.

Compatibility of the intended parking and transfer use to land use in the surrounding area has also been considered as a criterion for evaluating satellite parking candidate locations. The use to support Deer Island construction could extend through a period of between five and ten years. Compatibility with nearby land use has been considered, therefore, both in terms of present or committed land-use development and the planned intentions of local municipalities and others.

Related to the matter of land use is the degree of public controversy that might surround commitments that would be needed to allow satellite parking and bus transfer services to be established to support the Deer Island construction. The possibility that an action to secure such arrangements in any location might engender an unacceptable level of public controversy has been weighed in the evaluations performed.

Since the satellite parking concept is dependent on transfer of workers to and from the construction site itself by bus, the ease of access for bus movements entering and leaving the satellite parking locations has also been considered. In this, since the level of service needed to carry as many as half of the expected construction workers would not require bus service movements at intervals shorter than two minutes, problems of access for entry to and egress from the satellite parking locations are not likely to be great. In general, no more than one bus vehicle would need to be present at any satellite parking site at any given time, and sufficient time would be available to load or unload and depart from the site well before the next bus would seek entry to achieve the same purposes.

In addition, possibilities for significant advantage in the matter of bus service operating efficiencies have been considered as a separate criteria. In the interest of spreading load and using multiple sites for satellite parking, the options that may exist for using a linked bus service pattern that would have buses moving over a prescribed route and stopping at more than one parking facility have been considered, as well as the direct service arrangements that may be more appropriate at times of particularly large transfer loads.

Given all of this, a criterion of significant importance relates to the severity of residual impact that the traffic movements and bus services supporting the Deer Island construction workers may have on local street traffic and other public transport operations. In assessing residual transportation impact, both existing conditions and those expected to prevail with the Deer Island services in place must be considered, and the specific locations, times and manner of adverse impact must be considered. Along with this, the relative ease that may reside in steps that would be taken to mitigate potential impact has also been considered as a general criterion.

Finally, relative approximate costs associated with all of the actions that would be taken have been considered. These extend to the requirements for securing land or facilities for use, building or improving parking facilities, operating the parking facilities (including necessary security arrangements), and the operation of the transfer bus services that would carry workers to and from the Deer Island worksite.

The use of these criteria in evaluation of candidate locations for satellite parking is described more fully in a later section of this report, where the available information on each site has also been arrayed to support the evaluations made and the conclusions drawn.

4.5 LOCATIONS ASSESSMENT

The initial choice of possible satellite parking locations has been based on location and present use. After observance in the field, the following eight locations were selected as possible satellite parking options as illustrated in Figure K-5:

1) The Orient Heights MBTA Blue Line Station

2) The Suffolk Downs MBTA Blue Line Station

3) The Beachmont MBTA Blue Line Station

4) The Suffolk Downs Race Track

5) The Revere Beach MBTA Blue Line Station

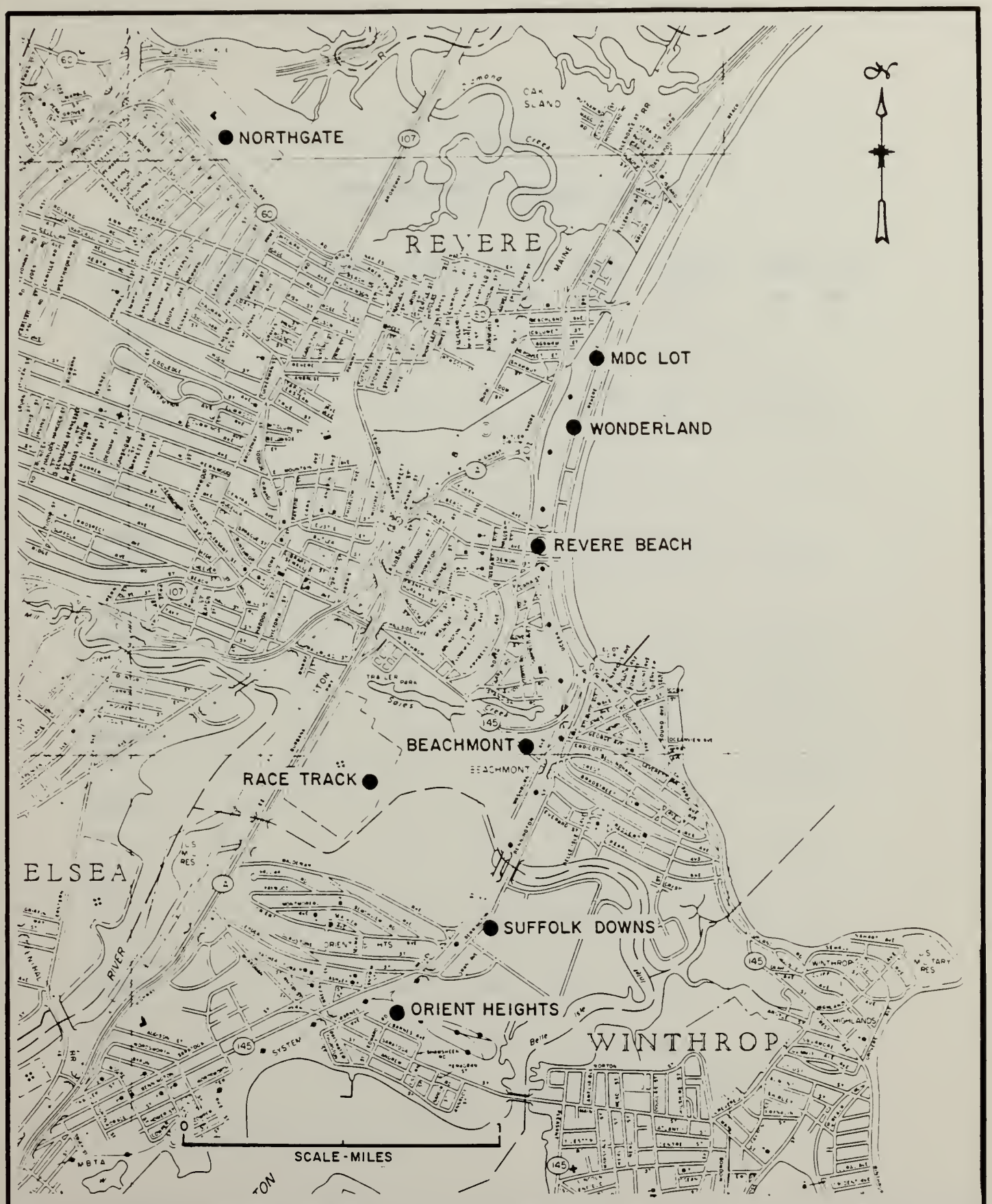
6) The Wonderland MBTA Blue Line Station

7) The Metropolitan District Commission Lot next to or north of the Wonderland Station and

8) The Northgate Shopping Center.

Table K-6 presents a site selection criteria matrix. The twelve criteria described in the previous sections were each applied to the eight sites. For each site a criterion was rated as good (G), fair (F), poor (P) or not applicable (N/A). Inspection of the matrix shows that the Suffolk Downs Station, the Beachmont Station, the Wonderland Station, and the Northgate Shopping Center may be eliminated as possible sites. A summarized assessment of each of these four sites can be found in the paragraphs below.

The Suffolk Downs Station and parking facility both lie east of the Blue Line tracks, along the west side of Bennington Street. It is the eighth stop on the Blue Line route which originates at Bowdoin Station in Boston and terminates at Wonderland Station in Revere. Approximately 180 commuter vehicles are parked along each curb of Bennington Street in the vicinity of the Suffolk Downs platforms, filling the majority of parking spaces throughout the day. The Suffolks Downs Station off-street parking lot has space for approximately 100 automobiles, and is also filled by commuter vehicles. Construction of additional parking space at Suffolk Downs would be expensive and controversial, since all of the nearby ground is in salt marsh fens. Land east of Bennington Street is part of Frederick's Park, and not likely to be available for parking facility construction.



MASSACHUSETTS WATER RESOURCES AUTHORITY

FIGURE K-5
SATELLITE PARKING FACILITEIS CANDIDATE SITES

TABLE K-6

SITE SELECTION CRITERIA MATRIX

Criteria	Orient Heights	Suffolk Downs	Beach-mont	Race Track	Revere Beach	Wonder-land	MDC Lot	North-gate
Worker Access	G	G	G	G	G	G	G	G
Proximity	G	G	G	G	G	G	G	P
Exstg Prkg	P	P	F	G	P	P	G	G
Arrange ments	G	G	N/A	G	P	P	G	F
Improve ments	G	P	P	G	P	G	G	G
Security	G	G	G	G	P	G	G	F
Compati bility	G	P	G	G	G	G	G	G
Contro versy	G	P	G	G	P	G	G	G
Bus Access	G	G	G	G	G	G	G	G
Transprtn Impacts	G	G	G	G	G	G	G	P
Cost	G	P	N/A	G	G	G	G	G

The Beachmont Station is an elevated structure carrying the Blue Line over Winthrop Avenue in Revere. It is the next stop north of the Suffolk Downs Station on the Blue Line route. Parking for this station is located on the west side of the Blue Line tracks, where an at-grade lot has been built to accomodate approximately 400 automobiles. Most of these spaces are currently occupied by commuter vehicles throughout the day. Expansion of the lot is precluded by surrounding roadways and land development. It is possible that a parking garage could be built on the lot; however, the required construction would interrupt use of off-street station parking at the station.

The Revere Beach Station is located on Shirley Street west of Ocean Avenue. Ocean Avenue turns into Bennington Street 1 mile south of the Station. The station has no off-street parking facilities and there is no land readily available for parking facility development. Commuters accessing this portion of the Blue Line park their automobiles along Ocean Avenue. The curb-side parking is currently restricted between the hours of 7:00 and 9:30 a.m. to alternate sides of the street, dependent on the day. This limitation effectively restricts commuter parking to only one side of the street. The 200 parking spaces available on any given day are currently all used by commuters. It is possible that parking regulation could be revised to allow Deer Island construction workers to park in the currently restricted areas. However, there would be limited security for vehicles and it would greatly decrease parking availability for persons traveling to area beaches and commercial destinations.

The Wonderland Station has a large lot containing approximately 650 parking spaces on the west side of the Blue Line tracks, just south of the Wonderland Ballroom. This lot is filled by commuters' vehicles through most of the day. There is also a smaller lot of 250 spaces on the east side of the Blue Line tracks at the Wonderland Station. It is also filled throughout the day. The MBTA has formulated plans to improve the Wonderland Station. These plans include a garage located on the western parking lot. It is intended that the garage be used by Blue Line commuters. The current and projected need for Blue Line commuter parking at the Wonderland Station makes it a less viable site for Deer Island satellite parking.

Finally, the Northgate shopping center has also been eliminated as a possible satellite parking area. The Center is located in the northwestern section of Revere on Squire Road, just south of its junction with Route 1. Of the eight sites considered, Northgate is the farthest from Deer Island. In addition, its lack of proximity to other satellite parking areas would lower bus routing efficiency and a separate bus route would be required to service this site. The current traffic congestion along Squire Road raises questions concerning the ability of current traffic to subsume construction worker traffic without unacceptable effects.

While the sites above fall short on the twelve criteria, the Orient Heights Station, the Suffolk Downs Race Track, and the MDC Lot score highly. In all cases, access is easy and proximity to Deer Island and to each other is close. This proximity will reduce operating costs and will increase bus transport efficiency.

The three sites are all currently used as parking facilities and both the Race Track and the MDC Lot could accommodate increased parking at their present capacities. Available parking at the Orient Heights Station could be increased by approximately 50 additional spaces at a relatively low cost.

Current operations and activities at the three sites would not be greatly affected by the proposed parking facilities since planned use does not differ from present use. Security would continue in the same manner with improvements and cost-sharing implemented as warranted. Compatability with nearby land uses would not be a problem, and issues of public controversy would be minimized. Necessary arrangements could evolve from current management procedures at the three parking facilities.

Required improvements to the sites would be minimal with the most extensive being new paving and striping. Also bus routing need only cover a limited distance and number of vehicles. Consequently, the cost of development and operations of the satellite parking facilities would be low.

Detailed descriptions of the Orient Heights Station, the Suffolk Downs Race Track and the MDC Lot are contained in the sections that follow.

4.6 INTERSECTION ANALYSIS

Analyses have been performed for street intersections potentially affected by Deer Island construction worker traffic to and from satellite parking sites. Intersection traffic volumes were estimated using recent traffic count data. Deer Island construction worker movements were then estimated under worst-case conditions. The following computed estimates have been made for each intersection, under existing conditions and with satellite parking:

1) Service Level for each intersection approach.

2) Service Level for the intersection as a whole.

3) Delay in vehicle-hours for each intersection approach.

4) Delay in vehicle-hours for the intersection as a whole.

5) Average queue length for each intersection approach.

All estimates have been developed assuming no change of existing cartway widths, curbside parking practice, or signal phasing. In cases where the intersection is not now controlled by a phased signal, an 80-second signal length has been applied for purposes of this analysis.

The intersections potentially affected by Deer Island construction worker satellite parking are listed in Table K-7.

TABLE K-7

STREET INTERSECTIONS POTENTIALLY AFFECTED BY DEER ISLAND SATELLITE PARKING

Intersections	Satellite Facility
Bennington Street/Saratoga Street	Orient Heights Station
Lee Burbank Highway/Suffolk Downs Race Track	Suffolk Downs Race Track
North Shore Road/Revere Beach Parkway	Suffolk Downs Race Track
Ocean Avenue/Beach Street	MDC Lot
Ocean Avenue/Revere Street	MDC Lot

Table K-8 summarizes the existing condition service levels. The table shows the intersection peak traffic volumes, effective capacity, signal cycle time, estimated overall service level and computed average delay for each intersection under existing conditions. In all cases, the overall service level is A. Attachment A contains the existing condition service level analyses.

TABLE K-8

EXISTING CONDITION SERVICE LEVELS

Intersection	Peak-Hour Volume	Effective Capacity	Cycle Time (sec)	Overall Srvc Lvl	Avg Delay Per Vhcl (sec)
Bennington & Saratoga	2,250	4,799	113	A	18
Lee Burbank & Race Track	3,622	7,013	80	A	14
North Shore & Revere Beach	2,709	7,664	246	A	14
Ocean & Beach	1,050	4,821	80	A	11
Ocean & Revere	670	7,282	80	A	2

Table K-9 summarizes the future condition service levels using the worst-case condition for each of the three satellite parking sites. The table shows the intersection peak traffic volumes, effective capacity, signal cycle time, estimated overall service level, and computed average delay for each intersection under proposed satellite parking conditions. Attachment D contains the future condition service level analyses.

TABLE K-9

FUTURE CONDITION SERVICE LEVELS
DEER ISLAND SATELLITE PARKING

Intersection	Peak-Hour Volume	Effective Capacity	Cycle Time (sec)	Overall Srvc Lvl	Avg Delay Per Vhcl (sec)
Bennington & Saratoga	2,438	4,719	113	A	20
Lee Burbank & Race Track	3,898	6,956	80	A	16
North Shore & Revere Beach	3,005	7,664	246	A	15
Ocean & Beach	1,188	4,789	80	A	12
Ocean & Revere	788	7,282	80	A	3

Each intersection has been examined under existing conditions and under worst-case future conditions which account for Deer Island construction workers traveling to and from satellite parking sites. Existing and future conditions are described by intersection in the paragraphs below.

Worst-case conditions for Orient Heights include 50 Shift-1 Deer Island construction worker automobiles traveling through the intersection of Bennington and Saratoga Streets. Worst-case conditions for the Suffolk Downs Race Track include 125 Shift-1 Deer Island Construction worker automobiles leaving, and 150 Shift-2 workers arriving through the intersections of the Lee Burbank Highway and the Suffolk Downs Racetrack entrance, and North Shore Road and the Revere Beach Parkway. In analyzing these two intersections, it has been assumed that all 275 workers might access the race track at one entrance. Worst-case conditions for the MDC Lot include 125 Shift-1 Deer Island construction worker automobiles leaving and 150 Shift-2 workers arriving through the intersections of Ocean Avenue and Beach Street, and Ocean Avenue and Revere Street.

1) Bennington Street and Saratoga Street - The peak hour at this location occurs between

5:00 and 6:00 PM. The largest peak-hour volumes occur on the Bennington Street southbound and northbound approaches. The total peak-hour volume for the intersection is 2,250, and the signal cycle time is 113 seconds. The estimated Deer Island construction worker peak-hour automobile volume through this intersection is 50 automobiles. The computer analysis reports enclosed show that the intersection currently performs at Service Level A, and will continue to do so with the estimated level of worker traffic.

2) Lee Burbank Highway and Suffolk Downs Race Track - The peak hour at this location occurs between 4:30 and 5:30 PM. The largest peak-hour volumes occur on the Lee Burbank Highway southbound and northbound approaches. The total peak-hour volume for the intersection is 3,622, and the intersection is currently uncontrolled. The estimated Deer Island construction worker peak-hour automobile volume through this intersection is 275 automobiles. In this analysis, it has been assumed that all 275 automobiles might access the race track through this intersection. The computer analysis reports enclosed show that the intersection currently performs at Service Level A, and will continue to do so with the estimated level of worker traffic.

3) North Shore Road and Revere Beach Parkway - The peak hour at this location occurs between 4:45 and 5:45 PM. The largest peak-hour volumes occur on the Revere Beach Parkway eastbound and westbound approaches. The total peak-hour volume for the intersection is 2,709, and the signal cycle time is 246. The estimated Deer Island construction worker peak-hour automobile volume through this intersection is 275 automobiles. In this analysis, it has been assumed that all 275 automobiles might access the race track through this intersection. The computer analysis reports enclosed show that the intersection currently performs at Service Level A, and will continue to do so with the estimated level of worker traffic.

4) Ocean Avenue and Beach Street - The peak hour at this location occurs between 7:00 and 8:00 AM. The largest peak-hour volumes occur on the Ocean Avenue southbound and the Beach Street eastbound approaches. The total peak-hour volume for the intersection is 1,050, and the intersection is currently uncontrolled. The estimated Deer Island construction worker peak-hour automobile volume through this intersection is 275 automobiles. The computer analysis reports enclosed show that the intersection currently performs at Service Level A, and will continue to do so with the estimated level of worker traffic.

5) Ocean Avenue and Revere Street - The peak hour at this location occurs between 7:00 and 8:00 AM. The largest peak-hour volumes occur on the Ocean Avenue southbound and northbound approaches. The total peak-hour volume for the intersection is 670, and the intersection is currently uncontrolled. The estimated Deer Island construction worker peak-hour automobile volume through this intersection is 275 automobiles. The computer analysis reports enclosed show that the intersection currently performs at Service Level A, and will continue to do so with the estimated level of worker traffic.

4.7 RECOMMENDED SITES

4.7.1 ORIENT HEIGHTS STATION

The Orient Heights MBTA Station (Orient Heights) is located north of the intersection of Bennington and Saratoga Streets in East Boston. It is just south of the principal maintenance shops and storage yard for the Blue Line. The parking lot lies generally north of the station platforms and south of the maintenance facilities, and is east of the Blue Line tracks. Use of the parking lot requires a daily fee of $1.00.

Orient Heights is the seventh stop when traveling east along the MBTA Blue Line. The Blue Line provides access to Boston's north shore suburbs with connections to public transit lines serving the entire Boston Metropolitan area.

Parking at Orient Heights accommodates approximately 400 vehicles. Since the facility is used primarily for commuter purposes, spaces fill in the morning before 8:00 a.m. and remain filled for the most part until approximately 6:00 p.m.

Space not currently in use between the northern end of the existing parking lot and the southern access road into the maintenance yard could be developed to accommodate approximately 50 additional automobiles. The required work involves initial site preparation, paving and striping.

The existing bus boarding area is south of the present parking lot on the east side of the station platforms. Workers arriving at the station by automobile and parking in the newly-constructed lot would have a relatively long walk to this boarding area. However, buses could collect workers arriving via the Blue Line at the existing stop and then proceed to a new bus stop near the intersection of Saratoga Street and St. Edward Road to collect workers arriving by automobile. This new stop would provide close access to the parking facility without taking the bus over residential streets.

Workers traveling to Orient Heights by car would travel mainly on Bennington Street, through the intersection of Bennington Street and Saratoga Street and then east on Saratoga Street to the station parking lot. The Bennington Street and Saratoga Street intersection could be affected by the construction worker traffic.

Fifty additional parking spaces at the Orient Heights Station could generate an additional 50 automobiles entering and exiting the lot during construction. Because of the relatively small amount of parking available, it is possible that one construction shift could generate all the additional traffic. This worst-case scenario has been used in analyzing the Bennington and Saratoga Streets intersection. The analysis results show no decrease in the existing level of service at the Bennington Street and Saratoga Street intersection.

4.7.2 SUFFOLK DOWNS RACE TRACK

The Suffolk Downs Race Track is west of the Beachmont Station between Bennington Street and North Shore Drive. The track holds races from 1:00 to 5:00 pm daily except Tuesday and Thursday, and seats 20,000 spectators.

The Suffolk Downs Race Track has a parking capacity of approximately 3,000 spaces. During non-racing days, the parking facilities are virtually unused. During race days, approximately one-fourth of track parking, or 750 spaces are unused and could be made available for Deer Island worker parking. Parking facility improvement requirements for this option are minimal. Repaving and restriping the lot would increase parking safety and efficiency.

The race track is accessible by foot from both the Suffolk Downs and Beachmont MBTA Blue Line Stations. The southeast portion of the race track parking lot is connected to the western portion of the Suffolk Downs Station by a small roadway. Race track patrons arriving via the Suffolk Downs Station are collected at the southern portion of the track parking lot by a race-track bus that takes them directly to the track entrance. Construction worker transport buses could easily pick up workers arriving by the Blue Line at this station location.

The Beachmont Station, though farther from the parking lot entrance, is also within walking distance of the track. Workers getting off at the Beachmont station, as well as those choosing to park automobiles at Beachmont station parking facilities, could reach the Suffolk Downs Race Track lot by foot if willing to walk a distance of 450 yards along Winthrop Avenue. Most workers accessing buses at the Suffolks Downs Race Track lot would travel by automobile with only a minimal percentage arriving by public transit.

The track can be accessed by automobile from either the Revere Beach Parkway or the Lee Burbank Highway (Route 1A). Both routes are able to carry high volumes of traffic. The Revere Beach Parkway is commercial and has two through lanes in each direction. Workers traveling westbound are provided with a left-turn exit lane into the track. Route 1A is a highway with two through lanes in each direction. An exit is accessible in each direction that leads directly into the southwest portion of the race track parking lot. Workers traveling on 1A southbound are provided with a left-turn exit lane.

Observation of general traffic conditions in the Suffolk Downs Race Track vicinity has shown adequate traffic flow through intersections and along roadways. Two intersections that could be affected by construction worker automobile traffic have been identified. These intersections are:

1) Lee Burbank Highway and the race track

2) North Shore Drive, Revere Beach Parkway and the race track

It is estimated that at least 300 spaces are required for construction worker vehicle parking

at any given time. These 300 spaces could generate up to 300 additional vehicles along roadways in the Race Track vicinity during construction shift change intervals. This worst case scenario has been used in analyzing the above intersections. The analysis results show no decrease in existing levels of service at the intersections.

4.7.3 METROPOLITAN DISTRICT COMMISSION LOT

To the north, and within walking distance of the Wonderland terminus for the Blue Line, a large paved area lies on the west side of Ocean Avenue. The paved area is large enough to accommodate parking for approximately 700 automobiles, although it is not currently striped and marked for such use.

The space nevertheless currently accommodates approximately 300 automobiles parked daily by commuters who walk from this location to the Wonderland Station platforms. The ground is owned by the Metropolitan District Commission, which provides security surveillance. A contract operator collects a daily fee of $1.00 per day per vehicle.

The unused portion of this paved area could provide a significant amount of parking to accommodate workers bound for the Deer Island site. With paving and striping, approximately 300 spaces could be available for worker automobiles. Most workers accessing busses at the MDC lot would travel by automobile. It is expected that only a minimal percentage will arrive via public transit.

Workers traveling by automobile to the MDC lot would do so via Ocean Avenue. Observation of traffic in the vicinity of the MDC lot shows an adequate flow of traffic along roadways and through intersections. Two intersections that could be affected by construction worker automobile traffic have been identified. These are:

1) Ocean Avenue and Beach Street, and

2) Ocean Avenue and Revere Street

It is estimated that at least 300 spaces are required for construction worker vehicle parking at any given time. These spaces could generate up to an additional 300 vehicles along roadways in the immediate MDC lot vicinity during construction shift change intervals. This worst case scenario has been used in analyzing the above intersections. The analysis shows no decrease in existing service levels at the intersections.

4.8 BUS SERVICE OPERATING PLAN

Public transport service by bus in Winthrop is currently provided by a privately-owned company named Rapid Transit, Inc. The bus system garage and offices are at 52 Crest Avenue in Winthrop. The fleet of vehicles currently operated is approximately 10.

Two routes within Winthrop are operated, both providing connection to the Orient Heights

Station of the MBTA Blue Line. A third route provides connected service by transfer from both of the other routes to Point Shirley and Deer Island.

The two routes through Winthrop serve the downtown center and the Highlands section of town along the northern portion of Route 145. The service to and from Point Shirley operates only to the transfer point in Winthrop Beach.

The transfer among buses occurs in the intersections at Shirley Street and Washington Avenue, and Washington Avenue and Veterans Road. Buses occupy curbside space and wait for connecting arrivals. The presence of the buses causes no observed traffic delay at these locations, even during peak periods of travel. Arrangements for more effective transfer, with even less potential impact on traffic flow through the intersections, can be made by using the undeveloped width of Veterans Road just north of Washington Avenue.

Schedules provide bus service at intervals that average 30-40 minutes for all routes, with shorter intervals during peak periods of operation:

1) Along the Highlands route in the morning peak, the average service interval is 12 minutes; in the evening peak, 10 minutes.

2) Through Winthrop Center, the morning peak has an average interval of 12 minutes; the evening peak, 10 minutes.

3) For short periods along the Winthrop Center route, the intervals between buses become 7 minutes in the morning peak and 8 minutes in the afternoon peak.

4) The service to and from Shirley Point is approximately 18 minutes on average during both the morning and afternoon peaks.

Scheduled running time to the Orient Heights Station is approximately 15 minutes at all times of the day. The service does not appear to be heavily used, except on selected movements during the morning or afternoon peak, where buses were observed to be at least two-thirds full. The current Rapid Transit, Inc. one-way fare between Winthrop and Orient Heights is $0.50.

As a regulated private company, the operator has a franchise allowing service to the Orient Heights Station only, with authority to pick up and discharge along Saratoga Street in East Boston between the Winthrop town line and the Orient Heights Station. Use of the Rapid Transit Inc. bus service beyond its current jurisdiction would require extending this existing authority. Action of the Massachusetts DPU would be needed to allow the company to serve the selected satellite parking facilities. As described in previous sections, three sites have been recommended as suitable satellite areas.

Figure K-6 shows the recommended satellite parking locations and the two proposed bus routes. Route 1 is identical to the existing Highlands Route. The Highlands Route uses Saratoga Street, Main Street, Revere Street, Crest Avenue, Veterans Road, Washington Avenue and Shirley Street for

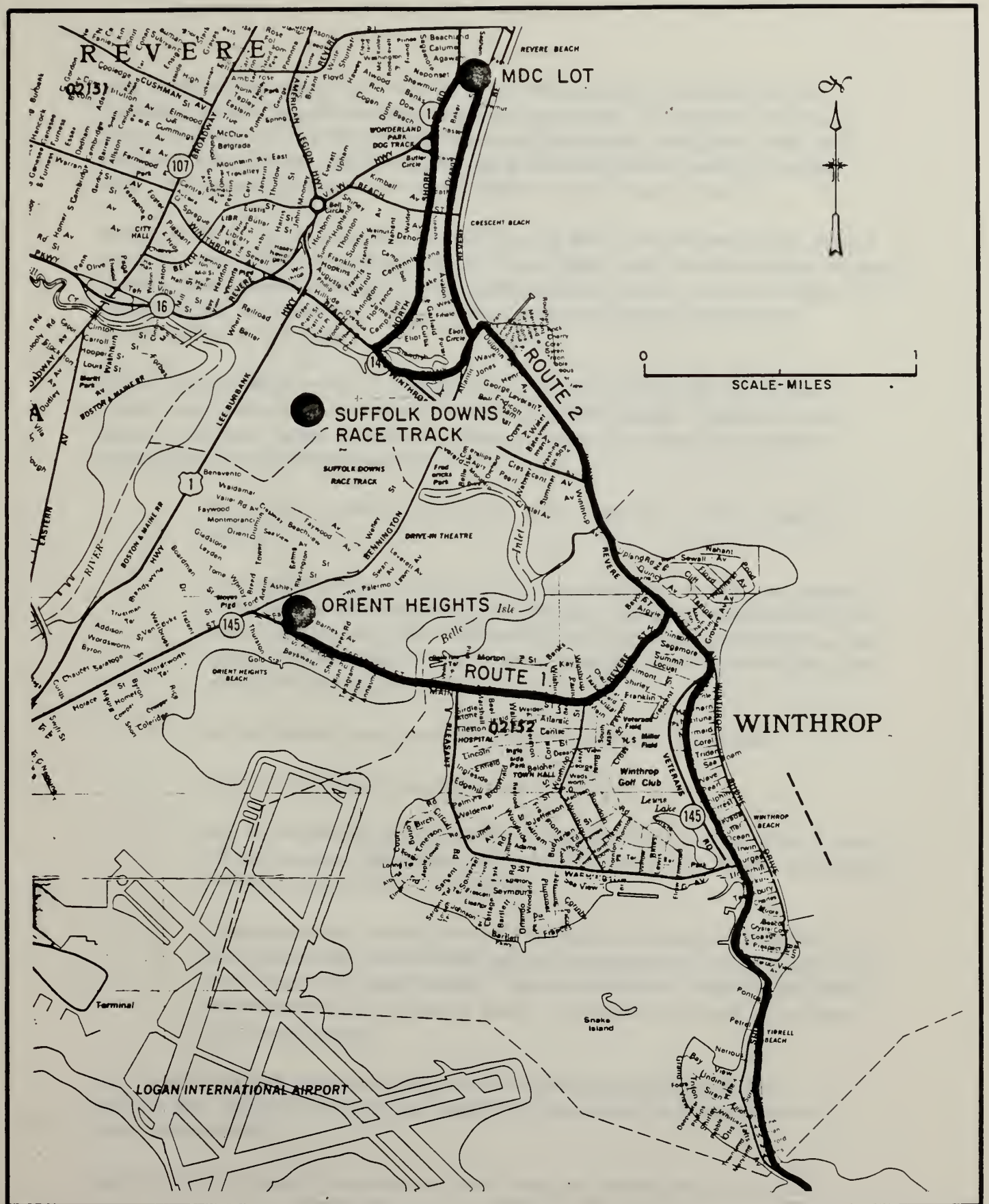


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FIGURE K-6
SATELLITE PARKING FACILITIES
RECOMMENDED SITES

travel between Orient Heights and Winthrop Beach. This existing service could easily be expanded to accomodate additional worker transport requirements. Some Route 1 buses could provide closed-door service between Deer Island and Orient Heights during peak worker shift changes to assure efficient transfer of workers using Orient Heights as a commuter transfer point. The roundtrip distance between Orient Heights and Deer Island is 9 miles.

Route 2 would provide service between the MDC Lot, the Race Track and Deer Island. Route 2 would use Shirley Street, Veterans Road, Crest Avenue, Revere Street, Winthrop Avenue, Winthrop Parkway, Ocean Avenue, North Shore Drive and Revere Beach Parkway for travel between the satellite facilities and Deer Island. The roundtrip distance between Deer Island and the satellite facilities is 10.5 miles.

Worker transport vehicles would be scheduled at intervals throughout the day with shorter intervals during shift changes and longer intervals between shift changes. Typical bus service operations have been defined for transport of workers between Deer Island and the satellite parking areas using the following criteria:

1) On average, two shifts of workers, five days a week, will be used to construct facilities.

2) Peak transport periods will occur at the beginning and end of shifts, and transport to and from the site during these peaks will occur during a 90-minute period. The worker transport peak period could overlap into the commuter peak period; however, worker trip travel would be in the opposite direction of commuter travel and would not interfere with commuters.

3) Service intervals would not exceed 15 minutes during the peak period.

4) At most, 600 workers a day will require bus transport.

5) Each satellite parking facility will have no more than two bus stops. Route 2 buses will also stop at the Wonderland and Suffolk Downs Blue Line Stations for transfer of workers using public transit to commute.

6) A base bus service between Deer Island and the satellite areas will be offered throughout the day to accommodate persons requiring travel to and from Deer Island at out-of-peak shift change intervals. Personnel traveling to Orient Heights would use the Highland Route scheduled service. A designated bus would service Route 2 during the off-period.

A percentage of the plant construction will require three and four daily shifts for short periods of time. Periodic service schedule revisions will be necessary to accommodate these special worker needs.

Approximately three Route 1 buses and four Route 2 buses are needed in the peak periods to

transport workers between Deer Island and satellite facilities. The service interval is 15 minutes, and buses travel at an average speed of 15 mph. Route 1 cycle time is 45 minutes and Route 2 cycle time is 50 minutes including allowance time for bus stop worker transfer. One-way trip travel time between Deer Island and satellite areas would not exceed 30 minutes.

4.9 ESTIMATED COSTS

Estimated costs for developing and operating the satellite parking areas and for operating the bus service are described in the paragraphs below.

Costs for parking facilities development to accommodate Deer Island construction worker vehicles at the three proposed satellite areas are relatively modest. At Orient Heights the area identified for development is currently unpaved. Improvement work includes initial site preparation, paving and striping. Orient Heights lot development costs are $100,000.

Suffolk Downs development costs include re-paving and re-striping a portion of the lot to provide 300 worker parking spaces. Suffolk Downs Race Track development costs are $600,000.

MDC Lot development costs include repaving and re-striping the lot to provide 300 spaces for worker vehicles. MDC Lot development costs are $600,000.

Costs for operating all three lots include wages for security personnel to assure unauthorized vehicles are not parked in spaces reserved for construction personnel, and that the worker vehicles parked in lots are not vandalized. All the satellite areas will require at least two security personnel, with each person working an 8-hour shift. Costs for security personnel at each lot are $95,000 a year. An extra security shift may be needed during periods when Deer Island Construction is a 24-hour a day operation. This requirement is not included in the above cost.

Costs for bus service operation would be based on a cost per worker trip. Operating costs would be recouped through the aggregate sum of worker-trips generated.

4.10 COST-SHARING ALTERNATIVES

The combined capacities of the three chosen sites could provide a significant amount of parking for Deer Island site workers if suitable arrangements for use could be worked out with current management. One possible arrangement might include a fixed fee per automobile paid by workers directly to lot attendants.

Another option is to provide workers with automobile stickers that authorize the use of reserved construction worker parking. Lump-sum payments to current management for parking lot use could then be made at suitable periodic intervals. At present time, both the Orient Heights and MDC parking lot management charge a daily fee of $1.00 for use of the facilities. General parking at the race-track is free.

Cost of security surveillance at the Orient Heights and MDC Lots could be shared by the Authority and current management. All security costs at the Race Track would be the responsiblty of the Authority. Security is currently provided at the Orient Heights and MDC Lots, and is minimal at the Race Track.

Costs for operating the bus service would not be shared by the Authority and the bus company. The bus company would be fairly recompensed for providing the service through worker trip fares. The advantage of this arrangement to the Authority is that the cost per worker trip would be minimized by using an already established bus service for worker transport.

4.11 PLANT PERSONNEL TRANSPORT

Plant adminstration, operation and maintenance personnel may also be transported between Deer Island and a satellite parking area or areas through Winthrop. Table K-10 shows the daily plant personnel requirements. Approximately 300 workers per day must be transported to Deer Island.

TABLE K-10

DAILY PLANT PERSONNEL REQUIREMENTS

	By 1995	By 1999
Total Primary, Secondary, and Residuals staff*	391	480
12 to 8 AM	14	19
8 AM to 4 PM	335	404
Total Deer Island staff, offduty, per day	28	38

* Total O&M staff estimate. Note that this is greater than the sum of the daily shift estimates, since the daily shift estimates do not reflect variation caused by holidays, weekends, etc.

Both the Suffolk Downs Race Track and MDC Lot have space to accomodate plant personnel parking requirements. Either one or both lots could be used as a permanent parking facility, provided suitable arrangements for permanent use of the sites could be worked out by the MWRA with current management.

Appendix K

Attachment

Signalled Intersection Analysis

SIGNALLED INTERSECTION ANALYSIS

MWRA DEER ISLAND TRFFC IMPACT — 319-06
Satellite Parking Intersection Performance — 17 SEP 87
BGS

INTERSECTION OF Bennininton & Saratoga Streets
Expected Traffic Volumes; Condition F-6 — WITH PARKNG

METROPOLITAN POPULATION 2,900,000 — CYCLE TIME 113 SEC
RESIDENTIAL — CLRNC TIME 4 SEC

APPROACH	APPRCH WIDTH (FT)	% SLOWNG TURNS	% CNFLCT TURNS	% TRCKS	PEAK HOUR FCTR	LOAD FCTR	GEOM FCTR	CPCTY (VPHG)
Bennington NB SRL	25.0	52.0	4.0	4.0	1.06	1.0	1.0	2,430
Bennington NB Right	13.0	100.0	0.0	4.0	1.16	0.7	1.0	1,330
Bennington SB SRL	27.0	13.0	40.0	4.0	1.01	0.7	1.0	2,050
Saratoga EB SRL	40.0	4.0	12.0	0.0	1.13	0.7	1.0	4,310
Saratoga WB SRL	22.0	20.0	57.0	5.0	1.13	0.7	1.0	2,550
Saratoga WB Left Sn	22.0	84.0	0.0	5.0	1.10	0.7	1.0	3,060

GREEN TIME AS PRESENTLY APPORTIONED

APPROACH	APPRCH VLM (VPH)	EFF G/C	EFFCTV CPCTY (VPH)	V/C	SRVC LVL	DLY PER VEHICLE (SEC)	TOTAL DELAY (VH-HR)	AVG QUEUE (VEH)
Bennington NB SRL	679	0.28	680	1.00	E	40.7	7.7	8
Bennington NB Right	355	0.42	559	0.64	B	18.6	1.8	6
Bennington SB SRL	323	0.29	574	0.56	A	14.6	1.3	4
Saratoga EB SRL	335	0.22	948	0.35	A	6.3	0.6	4
Saratoga WB SRL	373	0.22	561	0.66	B	19.7	2.0	5
Saratoga WB Left Sn	373	0.46	1,408	0.26	A	3.7	0.4	3
INTERSECTION TOTALS	2,438		4,730	0.51	A		13.8	

SIGNALLED INTERSECTION ANALYSIS

MWRA DEER ISLAND TRFFC IMPACT — 319-06
Satallite Parking Intersection Performance — 16 SEP 87
BGS

INTERSECTION OF Lee Burbank & Race Track
Expected Traffic Volumes; Condition F-6 — WITH PARKNG

METROPOLITAN POPULATION 2,900,000 — CYCLE TIME 80 SEC
RESIDENTIAL — CLRNC TIME 4 SEC

APPROACH	APPRCH WIDTH (FT)	% SLOWNG TURNS	% CNFLCT TURNS	% TRCKS	PEAK HOUR FCTR	LOAD FCTR	GEOM FCTR	CPCTY (VPHG)
Lee Burbank NB SR	35.0	13.0	0.0	0.0	1.20	1.0	1.0	6,530
Lee Burbank SB SL	35.0	0.0	15.0	0.0	1.20	0.7	1.0	5,450
Race Track WB LR	15.0	39.0	61.0	0.0	1.20	0.7	1.0	1,770

GREEN TIME AS PRESENTLY APPORTIONED

APPROACH	APPRCH VLM (VPH)	EFF G/C	EFFCTV CPCTY (VPH)	V/C	SRVC LVL	DLY PER VEHICLE (SEC)	TOTAL DELAY (VH-HR)	AVG QUEUE (VEH)
Lee Burbank NB SR	2,182	0.52	3,396	0.64	B	18.6	11.3	11
Lee Burbank SB SL	1,267	0.52	2,834	0.45	A	9.8	3.4	4
Race Track WB LR	449	0.41	726	0.62	B	17.6	2.2	6
INTERSECTION TOTALS	3,898		6,956	0.56	A		16.9	

SIGNALLED INTERSECTION ANALYSIS

MWRA DEER ISLAND TRFFC IMPACT — 319-06
Satellite Parking Intersection Performance — 17 SEP 87
BGS

INTERSECTION OF North Shore Road & Revere Beach Parkway
Expected Traffic Volumes; Condition F-6 — WITH PARKNG

METROPOLITAN POPULATION 2,900,000 — CYCLE TIME 246 SEC
RESIDENTIAL — CLRNC TIME 4 SEC

APPROACH	APPRCH WIDTH (FT)	% SLOWNG TURNS	% CNFLCT TURNS	% TRCKS	PEAK HOUR FCTR	LOAD FCTR	GEOM FCTR	CPCTY (VPHG)
SD Race Track NB RL	50.0	100.0	0.0	0.0	1.20	0.7	1.0	8,280
North Shore SB RL	20.0	100.0	0.0	0.0	1.20	0.7	1.0	3,120
Revere Beach EB SR	37.0	20.0	0.0	0.0	1.20	0.7	1.0	6,170
Revere Beach EB L	19.0	100.0	0.0	0.0	1.20	1.0	1.0	3,200
Revere Beach WB SR	37.0	14.0	0.0	0.0	1.20	0.7	1.0	6,170
Revere Beach WB L	10.0	100.0	0.0	0.0	1.20	1.0	1.0	1,780

GREEN TIME AS PRESENTLY APPORTIONED

APPROACH	APPRCH VLM (VPH)	EFF G/C	EFFCTV CPCTY (VPH)	V/C	SRVC LVL	DLY PER VEHICLE (SEC)	TOTAL DELAY (VH-HR)	AVG QUEUE (VEH)
SD Race Track NB RL	286	0.37	3,064	0.09	A	0.9	0.1	6
North Shore SB RL	278	0.20	624	0.45	A	9.8	0.8	15
Revere Beach EB SR	1,094	0.29	1,789	0.61	B	17.1	5.2	26
Revere Beach EB L	140	0.08	256	0.55	A	14.2	0.6	9
Revere Beach WB SR	1,144	0.29	1,789	0.64	B	18.6	5.9	27
Revere Beach WB L	63	0.08	142	0.44	A	9.5	0.2	4
INTERSECTION TOTALS	3,005		7,664	0.39	A		12.8	

SIGNALLED INTERSECTION ANALYSIS

MWRA DEER ISLAND TRFFC IMPACT — 319-06
Satallite Parking Intersection Performance — 16 SEP 87
BGS

INTERSECTION OF Ocean Avenue & Beach Street
Expected Traffic Volumes; Condition F-6 — WITH PRKNG

METROPOLITAN POPULATION 2,900,000 — CYCLE TIME 80 SEC
RESIDENTIAL — CLRNC TIME 4 SEC

APPROACH	APPRCH WIDTH (FT)	% SLOWNG TURNS	% CNFLCT TURNS	% TRCKS	PEAK HOUR FCTR	LOAD FCTR	GEOM FCTR	CPCTY (VPHG)
Ocean NB SL	25.0	0.0	33.0	0.0	1.20	0.7	1.0	2,390
Ocean SB SR	30.0	22.0	0.0	0.0	1.20	0.7	1.0	3,500
Beach EB RL	15.0	30.0	70.0	0.0	1.20	0.7	1.0	1,770
Beach WB SRL	15.0	0.0	0.0	0.0	1.20	0.7	1.0	2,980

GREEN TIME AS PRESENTLY APPORTIONED

APPROACH	APPRCH VLM (VPH)	EFF G/C	EFFCTV CPCTY (VPH)	V/C	SRVC LVL	DLY PER VEHICLE (SEC)	TOTAL DELAY (VH-HR)	AVG QUEUE (VEH)
Ocean NB SL	60	0.45	1,076	0.06	A	0.7	0.0	1
Ocean SB SR	913	0.45	1,575	0.58	A	15.6	4.0	5
Beach EB RL	165	0.45	797	0.21	A	2.6	0.1	2
Beach WB SRL	50	0.45	1,341	0.04	A	0.6	0.0	1
INTERSECTION TOTALS	1,188		4,789	0.24	A		4.1	

SIGNALLED INTERSECTION ANALYSIS

MWRA DEER ISLAND TRFFC IMPACT — 319-06
Satellite Parking Intersection Performance — 17 SEP 87
BGS

INTERSECTION OF Ocean Avenue & Revere Street
Expected Traffic Volumes; Condition F-6 — WITH PARKNG

METROPOLITAN POPULATION 2,900,000 — CYCLE TIME 80 SEC
RESIDENTIAL — CLRNC TIME 4 SEC

APPROACH	APPRCH WIDTH (FT)	% SLOWNG TURNS	% CNFLCT TURNS	% TRCKS	PEAK HOUR FCTR	LOAD FCTR	GEOM FCTR	CPCTY (VPHG)
Ocean NB L	20.0	0.0	100.0	0.0	1.20	0.7	1.0	2,810
Ocean SB SR	20.0	50.0	0.0	0.0	1.20	0.7	1.0	3,120
Revere EB R	20.0	100.0	0.0	0.0	1.20	0.7	1.0	3,120
Revere WB SR	40.0	0.0	0.0	0.0	1.20	0.7	1.0	7,130

GREEN TIME AS PRESENTLY APPORTIONED

APPROACH	APPRCH VLM (VPH)	EFF G/C	EFFCTV CPCTY (VPH)	V/C	SRVC LVL	DLY PER VEHICLE (SEC)	TOTAL DELAY (VH-HR)	AVG QUEUE (VEH)
Ocean NB L	313	0.45	1,265	0.25	A	3.5	0.3	4
Ocean SB SR	100	0.45	1,404	0.07	A	0.8	0.0	1
Revere EB R	325	0.45	1,404	0.23	A	3.0	0.3	4
Revere WB SR	50	0.45	3,209	0.02	A	0.6	0.0	0
INTERSECTION TOTALS	788		7,282	0.10	A		0.6	

SIGNALLED INTERSECTION ANALYSIS

MWRA DEER ISLAND TRFFC IMPACT — 301-04
Selectd-Hour Intersection Performance — 28 JUL 87
FJH

INTERSECTION OF Bennington & Saratoga Streets
Current Traffic Volumes: Condition E-2 — EXSTG CNDTN
Current Weekday Afternoon Peak Hour

METROPOLITAN POPULATION 2,900,000 — CYCLE TIME 110 SEC
RESIDENTIAL — CLRNC TIME 4 SEC

APPROACH	APPRCH WIDTH (FT)	% SLOWNG TURNS	% CNFLCT TURNS	% TRCKS	PEAK HOUR FCTR	LOAD FCTR	GEOM FCTR	CPCTY (VPHG)
Bennington NB SRL	25.0	50.0	4.0	2.0	1.06	1.0	1.0	2,480
Bennington NB Right	13.0	100.0	0.0	1.0	1.17	0.7	1.0	1,380
Bennington SB SRL	27.0	14.0	35.0	4.0	1.02	0.7	1.0	2,050
Saratoga EB SRL	40.0	4.0	12.0	0.0	1.13	0.7	1.0	4,310
Saratoga WB SRL	22.0	24.0	46.0	2.0	1.10	0.7	1.0	2,520
Saratoga WB Left Sn	22.0	70.0	0.0	2.0	1.10	0.7	1.0	3,150

GREEN TIME AS PRESENTLY APPORTIONED

APPROACH	APPRCH VLM (VPH)	EFF G/C	EFFCTV CPCTY (VPH)	V/C	SRVC LVL	DLY PER VEHICLE (SEC)	TOTAL DELAY (VH-HR)	AVG QUEUE (VEH)
Bennington NB SRL	654	0.28	694	0.94	E	36.7	6.7	7
Bennington NB Right	331	0.42	580	0.57	A	15.1	1.4	6
Bennington SB SRL	298	0.28	574	0.52	A	12.8	1.1	3
Saratoga EB SRL	335	0.22	948	0.35	A	6.3	0.6	4
Saratoga WB SRL	316	0.22	554	0.57	A	15.1	1.3	4
Saratoga WB Left Sn	316	0.46	1,449	0.22	A	2.8	0.2	3
INTERSECTION TOTALS	2,250		4,799	0.46	A		11.3	

SIGNALLED INTERSECTION ANALYSIS

MWRA DEER ISLAND TRFFC IMPACT
Selectd-Hour Intersection Performance

301-04
28 JUL 87
FJH

INTERSECTION OF Main and Pleasant Streets
Current Traffic Volumes: Condition E-2
Current Weekday Afternoon Peak Hour

EXSTG CNDTN

METROPOLITAN POPULATION 2,900,000
RESIDENTIAL

CYCLE TIME 94 SEC
CLRNC TIME 4 SEC

APPROACH	APPRCH WIDTH (FT)	% SLOWNG TURNS	% CNFLCT TURNS	% TRCKS	PEAK HOUR FCTR	LOAD FCTR	GEOM FCTR	CPCTY (VPHG)
Main EB SRL	28.0	33.0	0.0	0.0	1.18	0.7	1.0	4,590
Main EB Right	14.0	100.0	0.0	0.0	1.21	0.7	1.0	2,390
Main WB SRL	18.0	0.0	4.0	0.0	1.21	0.7	1.0	3,160
Pleasant NB SRL	14.0	12.0	87.0	0.0	1.35	0.7	1.0	1,850
Pleasant SB SRL	12.0	65.0	6.0	0.0	1.88	0.7	1.0	2,510

GREEN TIME AS PRESENTLY APPORTIONED

APPROACH	APPRCH VLM (VPH)	EFF G/C	EFFCTV CPCTY (VPH)	V/C	SRVC LVL	DLY PER VEHICLE (SEC)	TOTAL DELAY (VH-HR)	AVG QUEUE (VEH)
Main EB SRL	849	0.48	2,203	0.39	A	7.6	1.8	5
Main EB Right	278	0.31	741	0.38	A	7.3	0.6	5
Main WB SRL	312	0.48	1,517	0.21	A	2.6	0.2	4
Pleasant NB SRL	301	0.44	814	0.37	A	6.9	0.6	4
Pleasant SB SRL	17	0.13	326	0.05	A	0.6	0.0	1
INTERSECTION TOTALS	1,757		5,601	0.31	A		3.2	

SIGNALLED INTERSECTION ANALYSIS

MWRA DEER ISLAND TRFFC IMPACT — 301-04
Selectd-Hour Intersection Performance — 28 JUL 87
FJH

INTERSECTION OF Shirley and Revere Streets
Current Traffic Volumes: Condition E-2 — EXSTG CNDTN
Current Weekday Afternoon Peak Hour

METROPOLITAN POPULATION 2,900,000 — CYCLE TIME 68 SEC
RESIDENTIAL — CLRNC TIME 4 SEC

APPROACH	APPRCH WIDTH (FT)	% SLOWNG TURNS	% CNFLCT TURNS	% TRCKS	PEAK HOUR FCTR	LOAD FCTR	GEOM FCTR	CPCTY (VPHG)
Shirley NB RL	13.0	100.0	0.0	1.0	1.16	0.7	1.0	1,370
Revere EB SR	18.0	14.0	0.0	0.0	1.08	0.7	1.0	2,120
Revere EB Right	9.0	100.0	0.0	0.0	1.21	0.7	1.0	960
Revere WB SL	16.5	0.0	8.0	0.0	1.18	0.7	1.0	2,110

GREEN TIME AS PRESENTLY APPORTIONED

APPROACH	APPRCH VLM (VPH)	EFF G/C	EFFCTV CPCTY (VPH)	V/C	SRVC LVL	DLY PER VEHICLE (SEC)	TOTAL DELAY (VH-HR)	AVG QUEUE (VEH)
Shirley NB RL	172	0.35	480	0.36	A	6.6	0.3	2
Revere EB SR	579	0.53	1,124	0.52	A	12.8	2.1	5
Revere EB Right	82	0.41	394	0.21	A	2.6	0.1	1
Revere WB SL	559	0.53	1,118	0.50	A	11.9	1.8	5
INTERSECTION TOTALS	1,392		3,116	0.44	A		4.3	

SIGNALLED INTERSECTION ANALYSIS

MWRA DEER ISLAND TRFFC IMPACT — 301-04
Selectd-Hour Intersection Performance — 28 JUL 87
FJH

INTERSECTION OF Veterans HWY & Shirley Street
Current Traffic Volumes: Condition E-2 — EXSTG CNDTN
Current Weekday Afternoon Peak Hour

METROPOLITAN POPULATION 2,900,000 — CYCLE TIME 80 SEC
RESIDENTIAL — CLRNC TIME 4 SEC

APPROACH	APPRCH WIDTH (FT)	% SLOWNG TURNS	% CNFLCT TURNS	% TRCKS	PEAK HOUR FCTR	LOAD FCTR	GEOM FCTR	CPCTY (VPHG)
Shirley EB SRL	12.0	28.0	19.0	1.0	1.14	0.7	1.0	1,270
Shirley WB SRL	13.0	6.0	3.0	0.0	1.22	0.7	1.0	2,620
Veterans NB SRL	16.0	8.0	64.0	7.0	1.24	0.7	1.0	2,040
Veterans SB SRL	16.0	39.0	17.0	5.0	1.31	0.7	1.0	2,130

GREEN TIME AS PRESENTLY APPORTIONED

APPROACH	APPRCH VLM (VPH)	EFF G/C	EFFCTV CPCTY (VPH)	V/C	SRVC LVL	DLY PER VEHICLE (SEC)	TOTAL DELAY (VH-HR)	AVG QUEUE (VEH)
Shirley EB SRL	268	0.45	572	0.47	A	10.7	0.8	3
Shirley WB SRL	36	0.45	1,179	0.03	A	0.6	0.0	1
Veterans NB SRL	158	0.45	918	0.17	A	1.9	0.1	2
Veterans SB SRL	143	0.45	959	0.15	A	1.6	0.1	2
INTERSECTION TOTALS	605		3,628	0.16	A		1.0	

SIGNALLED INTERSECTION ANALYSIS

MWRA DEER ISLAND TRFFC IMPACT — 301-04
Selectd-Hour Intersection Performance — 28 JUL 87
FJH

INTERSECTION OF Veterans HWY & Washington Avenue
Current Traffic Volumes: Condition E-2 — EXSTG CNDTN
Current Weekday Afternoon Peak Hour

METROPOLITAN POPULATION 2,900,000 — CYCLE TIME 80 SEC
RESIDENTIAL — CLRNC TIME 4 SEC

APPROACH	APPRCH WIDTH (FT)	% SLOWNG TURNS	% CNFLCT TURNS	% TRCKS	PEAK HOUR FCTR	LOAD FCTR	GEOM FCTR	CPCTY (VPHG)
Washington EB SRL	20.0	0.0	10.0	1.0	1.20	0.7	1.0	3,280
Washington WB SRL	26.0	5.0	0.0	2.0	1.15	0.7	1.0	4,350
Veterans SB SRL	22.0	100.0	0.0	3.0	1.27	0.7	1.0	2,270

GREEN TIME AS PRESENTLY APPORTIONED

APPROACH	APPRCH VLM (VPH)	EFF G/C	EFFCTV CPCTY (VPH)	V/C	SRVC LVL	DLY PER VEHICLE (SEC)	TOTAL DELAY (VH-HR)	AVG QUEUE (VEH)
Washington EB SRL	387	0.45	1,476	0.26	A	3.7	0.4	5
Washington WB SRL	287	0.45	1,958	0.15	A	1.6	0.1	3
Veterans SB SRL	122	0.45	1,022	0.12	A	1.2	0.0	2
INTERSECTION TOTALS	796		4,456	0.17	A		0.5	

SIGNALLED INTERSECTION ANALYSIS

MWRA DEER ISLAND TRFFC IMPACT — 301-04
Selectd-Hour Intersection Performance — 28 JUL 87
FJH

INTERSECTION OF Shirley Street & Washington Avenue
Current Traffic Volumes: Condition E-2 — EXSTG CNDTN
Current Weekday Afternoon Peak Hour

METROPOLITAN POPULATION 2,900,000 — CYCLE TIME 80 SEC
RESIDENTIAL — CLRNC TIME 4 SEC

APPROACH	APPRCH WIDTH (FT)	% SLOWNG TURNS	% CNFLCT TURNS	% TRCKS	PEAK HOUR FCTR	LOAD FCTR	GEOM FCTR	CPCTY (VPHG)
Washington EB SRL	26.0	76.0	0.0	1.0	1.19	0.7	1.0	4,240
Shirley NB SRL	24.0	13.0	76.0	1.0	1.12	0.7	1.0	2,000
Shirley SB SRL	20.0	61.0	7.0	5.0	1.03	0.7	1.0	2,460

GREEN TIME AS PRESENTLY APPORTIONED

APPROACH	APPRCH VLM (VPH)	EFF G/C	EFFCTV CPCTY (VPH)	V/C	SRVC LVL	DLY PER VEHICLE (SEC)	TOTAL DELAY (VH-HR)	AVG QUEUE (VEH)
Washington EB SRL	424	0.45	1,908	0.22	A	2.8	0.3	5
Shirley NB SRL	285	0.45	900	0.32	A	5.3	0.4	3
Shirley SB SRL	114	0.45	1,107	0.10	A	1.0	0.0	1
INTERSECTION TOTALS	823		3,915	0.21	A		0.7	

SIGNALLED INTERSECTION ANALYSIS

MWRA DEER ISLAND TRFFC IMPACT — 301-04
Selectd-Hour Intersection Performance — 28 JUL 87
FJH

INTERSECTION OF Crest, Highland, and Revere
Current Traffic Volumes: Condition E-2 — EXSTG CNDTN
Current Weekday Afternoon Peak Hour

METROPOLITAN POPULATION 2,900,000 — CYCLE TIME 80 SEC
RESIDENTIAL — CLRNC TIME 4 SEC

APPROACH	APPRCH WIDTH (FT)	% SLOWNG TURNS	% CNFLCT TURNS	% TRCKS	PEAK HOUR FCTR	LOAD FCTR	GEOM FCTR	CPCTY (VPHG)
Highland WB SRL	13.0	27.0	11.0	0.0	1.13	0.7	1.0	1,600
Crest NB SRL	13.0	1.0	35.0	0.0	1.04	0.7	1.0	1,080
Revere EB SRL	21.0	15.0	62.0	0.0	1.12	0.7	1.0	2,600
Revere SB SRL	21.0	55.0	7.0	0.0	1.11	0.7	1.0	2,890

GREEN TIME AS PRESENTLY APPORTIONED

APPROACH	APPRCH VLM (VPH)	EFF G/C	EFFCTV CPCTY (VPH)	V/C	SRVC LVL	DLY PER VEHICLE (SEC)	TOTAL DELAY (VH-HR)	AVG QUEUE (VEH)
Highland WB SRL	81	0.45	720	0.11	A	1.1	0.0	1
Crest NB SRL	272	0.45	486	0.56	A	14.6	1.1	3
Revere EB SRL	420	0.45	1,170	0.36	A	6.6	0.8	5
Revere SB SRL	819	0.45	1,301	0.63	B	18.1	4.1	9
INTERSECTION TOTALS	1,592		3,677	0.43	A		6.0	

SIGNALLED INTERSECTION ANALYSIS

MWRA DEER ISLAND TRFFC IMPACT — 301-04
Selectd-Hour Intersection Performance — 29 JUL 87
FJH

INTERSECTION OF Veterans Road & Winthrop Shore Drive
Current Traffic Volumes: Condition E-2 — EXSTG CNDTN
Current Weekday Afternoon Peak Hour

METROPOLITAN POPULATION 2,900,000 — CYCLE TIME 80 SEC
RESIDENTIAL — CLRNC TIME 4 SEC

APPROACH	APPRCH WIDTH (FT)	% SLOWNG TURNS	% CNFLCT TURNS	% TRCKS	PEAK HOUR FCTR	LOAD FCTR	GEOM FCTR	CPCTY (VPHG)
Veterans EB RL	13.0	100.0	0.0	1.0	1.17	0.7	1.0	2,120
Winthrop NB SL	20.0	0.0	13.0	0.0	1.03	0.7	1.0	2,840
Winthrop SB SR	20.0	34.0	0.0	0.0	1.06	0.7	1.0	2,830

GREEN TIME AS PRESENTLY APPORTIONED

APPROACH	APPRCH VLM (VPH)	EFF G/C	EFFCTV CPCTY (VPH)	V/C	SRVC LVL	DLY PER VEHICLE (SEC)	TOTAL DELAY (VH-HR)	AVG QUEUE (VEH)
Veterans EB RL	82	0.45	954	0.09	A	0.9	0.0	1
Winthrop NB SL	275	0.45	1,278	0.22	A	2.8	0.2	3
Winthrop SB SR	404	0.45	1,274	0.32	A	5.3	0.6	5
INTERSECTION TOTALS	761		3,506	0.21	A		0.8	

SIGNALLED INTERSECTION ANALYSIS

MWRA DEER ISLAND TRFFC IMPACT — 301-04
Selectd-Hour Intersection Performance — 28 JUL 87
FJH

INTERSECTION OF Bennington & Saratoga Streets
Expected Traffic Volumes; Condition F-6 — +88 FROM DI
New Plant Weekday Afternoon Peak Hour

METROPOLITAN POPULATION 2,900,000 — CYCLE TIME 113 SEC
RESIDENTIAL — CLRNC TIME 4 SEC

APPROACH	APPRCH WIDTH (FT)	% SLOWNG TURNS	% CNFLCT TURNS	% TRCKS	PEAK HOUR FCTR	LOAD FCTR	GEOM FCTR	CPCTY (VPHG)
Bennington NB SRL	25.0	50.0	4.0	2.0	1.06	1.0	1.0	2,480
Bennington NB Right	13.0	100.0	0.0	1.0	1.17	0.7	1.0	1,380
Bennington SB SRL	27.0	14.0	35.0	4.0	1.02	0.7	1.0	2,050
Saratoga EB SRL	40.0	4.0	12.0	0.0	1.13	0.7	1.0	4,310
Saratoga WB SRL	22.0	21.0	48.0	5.0	1.08	0.7	1.0	2,450
Saratoga WB Left Sn	22.0	69.0	0.0	5.0	1.08	0.7	1.0	3,020

GREEN TIME AS PRESENTLY APPORTIONED

APPROACH	APPRCH VLM (VPH)	EFF G/C	EFFCTV CPCTY (VPH)	V/C	SRVC LVL	DLY PER VEHICLE (SEC)	TOTAL DELAY (VH-HR)	AVG QUEUE (VEH)
Bennington NB SRL	654	0.28	694	0.94	E	36.7	6.7	7
Bennington NB Right	331	0.42	580	0.57	A	15.1	1.4	6
Bennington SB SRL	298	0.28	574	0.52	A	12.8	1.1	3
Saratoga EB SRL	335	0.22	948	0.35	A	6.3	0.6	4
Saratoga WB SRL	361	0.22	539	0.67	B	20.2	2.0	4
Saratoga WB Left Sn	361	0.46	1,389	0.26	A	3.7	0.4	3
INTERSECTION TOTALS	2,340		4,724	0.49	A		12.2	

SIGNALLED INTERSECTION ANALYSIS

MWRA DEER ISLAND TRFFC IMPACT — 301-04
Selectd-Hour Intersection Performance — 28 JUL 87
FJH

INTERSECTION OF Main and Pleasant Streets
Expected Traffic Volumes: Condition F-6 — +88 FROM DI
New Plant Weekday Afternoon Peak Hour

METROPOLITAN POPULATION 2,900,000 — CYCLE TIME 94 SEC
RESIDENTIAL — CLRNC TIME 4 SEC

APPROACH	APPRCH WIDTH (FT)	% SLOWNG TURNS	% CNFLCT TURNS	% TRCKS	PEAK HOUR FCTR	LOAD FCTR	GEOM FCTR	CPCTY (VPHG)
Main EB SRL	28.0	33.0	0.0	0.0	1.18	0.7	1.0	4,590
Main EB Right	14.0	100.0	0.0	0.0	1.21	0.7	1.0	2,390
Main WB SRL	18.0	0.0	4.0	6.0	1.17	0.7	1.0	2,900
Pleasant NB SRL	14.0	12.0	87.0	0.0	1.35	0.7	1.0	1,850
Pleasant SB SRL	12.0	65.0	6.0	0.0	1.88	0.7	1.0	2,510

GREEN TIME AS PRESENTLY APPORTIONED

APPROACH	APPRCH VLM (VPH)	EFF G/C	EFFCTV CPCTY (VPH)	V/C	SRVC LVL	DLY PER VEHICLE (SEC)	TOTAL DELAY (VH-HR)	AVG QUEUE (VEH)
Main EB SRL	849	0.48	2,203	0.39	A	7.6	1.8	5
Main EB Right	278	0.31	741	0.38	A	7.3	0.6	5
Main WB SRL	400	0.48	1,392	0.29	A	4.5	0.5	5
Pleasant NB SRL	301	0.44	814	0.37	A	6.9	0.6	4
Pleasant SB SRL	17	0.13	326	0.05	A	0.6	0.0	1
INTERSECTION TOTALS	1,845		5,476	0.33	A		3.5	

SIGNALLED INTERSECTION ANALYSIS

MWRA DEER ISLAND TRFFC IMPACT — 301-04
Selectd-Hour Intersection Performance — 28 JUL 87
FJH

INTERSECTION OF Shirley and Revere Streets
Expected Traffic Volumes; Condition F-6 — +68 FROM DI
New Plant Weekday Afternoon Peak Hour

METROPOLITAN POPULATION 2,900,000 — CYCLE TIME 68 SEC
RESIDENTIAL — CLRNC TIME 4 SEC

APPROACH	APPRCH WIDTH (FT)	% SLOWNG TURNS	% CNFLCT TURNS	% TRCKS	PEAK HOUR FCTR	LOAD FCTR	GEOM FCTR	CPCTY (VPHG)
Shirley NB RL	13.0	100.0	0.0	10.0	1.11	0.7	1.0	1,210
Revere EB SR	18.0	14.0	0.0	0.0	1.08	0.7	1.0	2,120
Revere EB Right	9.0	100.0	0.0	0.0	1.21	0.7	1.0	960
Revere WB SL	16.5	0.0	8.0	0.0	1.18	0.7	1.0	2,110

GREEN TIME AS PRESENTLY APPORTIONED

APPROACH	APPRCH VLM (VPH)	EFF G/C	EFFCTV CPCTY (VPH)	V/C	SRVC LVL	DLY PER VEHICLE (SEC)	TOTAL DELAY (VH-HR)	AVG QUEUE (VEH)
Shirley NB RL	260	0.35	424	0.61	B	17.1	1.2	3
Revere EB SR	579	0.53	1,124	0.52	A	12.8	2.1	5
Revere EB Right	82	0.41	394	0.21	A	2.6	0.1	1
Revere WB SL	559	0.53	1,118	0.50	A	11.9	1.8	5
INTERSECTION TOTALS	1,480		3,060	0.48	A		5.2	

SIGNALLED INTERSECTION ANALYSIS

MWRA DEER ISLAND TRFFC IMPACT — 301-04
Selectd-Hour Intersection Performance — 28 JUL 87
FJH

INTERSECTION OF Veterans HWY & Washington Avenue
Expected Traffic Volumes: Condition F-6 — +88 FROM DI
New Plant Weekday Afternoon Peak Hour

METROPOLITAN POPULATION 2,900,000 — CYCLE TIME 80 SEC
RESIDENTIAL — CLRNC TIME 4 SEC

APPROACH	APPRCH WIDTH (FT)	% SLOWNG TURNS	% CNFLCT TURNS	% TRCKS	PEAK HOUR FCTR	LOAD FCTR	GEOM FCTR	CPCTY (VPHG)
Washington EB SRL	20.0	0.0	10.0	1.0	1.20	0.7	1.0	3,280
Washington WB SRL	26.0	27.0	0.0	8.0	1.12	0.7	1.0	3,760
Veterans SB SRL	22.0	100.0	0.0	3.0	1.23	0.7	1.0	2,270

GREEN TIME AS PRESENTLY APPORTIONED

APPROACH	APPRCH VLM (VPH)	EFF G/C	EFFCTV CPCTY (VPH)	V/C	SRVC LVL	DLY PER VEHICLE (SEC)	TOTAL DELAY (VH-HR)	AVG QUEUE (VEH)
Washington EB SRL	387	0.45	1,476	0.26	A	3.7	0.4	5
Washington WB SRL	375	0.45	1,692	0.22	A	2.8	0.3	4
Veterans SB SRL	122	0.45	1,022	0.12	A	1.2	0.0	2
INTERSECTION TOTALS	884		4,190	0.21	A		0.7	

SIGNALLED INTERSECTION ANALYSIS

MWRA DEER ISLAND TRFFC IMPACT — 301-04
Selectd-Hour Intersection Performance — 28 JUL 87
FJH

INTERSECTION OF Veterans HWY & Shirley Street
Expected Traffic Volumes: Condition F-6 — +88 FROM DI
New Plant Weekday Afternoon Peak Hour

METROPOLITAN POPULATION 2,900,000 — CYCLE TIME 80 SEC
RESIDENTIAL — CLRNC TIME 4 SEC

APPROACH	APPRCH WIDTH (FT)	% SLOWNG TURNS	% CNFLCT TURNS	% TRCKS	PEAK HOUR FCTR	LOAD FCTR	GEOM FCTR	CPCTY (VPHG)
Shirley EB SRL	12.0	28.0	19.0	1.0	1.14	0.7	1.0	1,270
Shirley WB SRL	13.0	6.0	3.0	0.0	1.22	0.7	1.0	2,620
Veterans NB SRL	16.0	5.0	77.0	14.0	1.11	0.7	1.0	1,760
Veterans SB SRL	16.0	39.0	17.0	5.0	1.31	0.7	1.0	2,130

GREEN TIME AS PRESENTLY APPORTIONED

APPROACH	APPRCH VLM (VPH)	EFF G/C	EFFCTV CPCTY (VPH)	V/C	SRVC LVL	DLY PER VEHICLE (SEC)	TOTAL DELAY (VH-HR)	AVG QUEUE (VEH)
Shirley EB SRL	268	0.45	572	0.47	A	10.7	0.8	3
Shirley WB SRL	36	0.45	1,179	0.03	A	0.6	0.0	1
Veterans NB SRL	246	0.45	792	0.31	A	5.1	0.3	3
Veterans SB SRL	143	0.45	959	0.15	A	1.6	0.1	2
INTERSECTION TOTALS	693		3,502	0.19	A		1.2	

SIGNALLED INTERSECTION ANALYSIS

MWRA DEER ISLAND TRFFC IMPACT — 301-04
Selectd-Hour Intersection Performance — 28 JUL 87
FJH

INTERSECTION OF Shirley Street & Washington Avenue
Expected Traffic Volumes; Condition F-6 — +88 FROM DI
New Plant Weekday Afternoon Peak Hour

METROPOLITAN POPULATION 2,900,000 — CYCLE TIME 80 SEC
RESIDENTIAL — CLRNC TIME 4 SEC

APPROACH	APPRCH WIDTH (FT)	% SLOWNG TURNS	% CNFLCT TURNS	% TRCKS	PEAK HOUR FCTR	LOAD FCTR	GEOM FCTR	CPCTY (VPHG)
Washington EB SRL	26.0	76.0	0.0	1.0	1.19	0.7	1.0	4,240
Shirley NB SRL	24.0	10.0	82.0	8.0	1.09	0.7	1.0	1,860
Shirley SB SRL	20.0	61.0	7.0	5.0	1.03	0.7	1.0	2,460

GREEN TIME AS PRESENTLY APPORTIONED

APPROACH	APPRCH VLM (VPH)	EFF G/C	EFFCTV CPCTY (VPH)	V/C	SRVC LVL	DLY PER VEHICLE (SEC)	TOTAL DELAY (VH-HR)	AVG QUEUE (VEH)
Washington EB SRL	424	0.45	1,908	0.22	A	2.8	0.3	5
Shirley NB SRL	373	0.45	837	0.45	A	9.8	1.0	4
Shirley SB SRL	114	0.45	1,107	0.10	A	1.0	0.0	1
INTERSECTION TOTALS	911		3,852	0.23	A		1.3	

SIGNALLED INTERSECTION ANALYSIS

MWRA DEER ISLAND TRFFC IMPACT — 301-04
Selectd-Hour Intersection Performance — 28 JUL 87
FJH

INTERSECTION OF Veterans Road & Winthrop Shore Drive
Expected Traffic Volumes; Condition F-6 — +88 FROM DI
New Plant Weekday Afternoon Peak Hour

METROPOLITAN POPULATION 2,900,000 — CYCLE TIME 80 SEC
RESIDENTIAL — CLRNC TIME 4 SEC

APPROACH	APPRCH WIDTH (FT)	% SLOWNG TURNS	% CNFLCT TURNS	% TRCKS	PEAK HOUR FCTR	LOAD FCTR	GEOM FCTR	CPCTY (VPHG)
Veterans EB RL	13.0	100.0	0.0	15.0	1.08	0.7	1.0	1,720
Winthrop NB SL	20.0	0.0	13.0	0.0	1.03	0.7	1.0	2,840
Winthrop SB SR	20.0	34.0	0.0	0.0	1.06	0.7	1.0	2,830

GREEN TIME AS PRESENTLY APPORTIONED

APPROACH	APPRCH VLM (VPH)	EFF G/C	EFFCTV CPCTY (VPH)	V/C	SRVC LVL	DLY PER VEHICLE (SEC)	TOTAL DELAY (VH-HR)	AVG QUEUE (VEH)
Veterans EB RL	170	0.45	774	0.22	A	2.8	0.1	2
Winthrop NB SL	275	0.45	1,278	0.22	A	2.8	0.2	3
Winthrop SB SR	404	0.45	1,274	0.32	A	5.3	0.6	5
INTERSECTION TOTALS	849		3,326	0.25	A		0.9	

SIGNALLED INTERSECTION ANALYSIS

MWRA DEER ISLAND TRFFC IMPACT — 301-04
Selectd-Hour Intersection Performance — 28 JUL 87
FJH

INTERSECTION OF Crest, Highland, and Revere
Expected Traffic Volumes: Condition F-6 — +88 FROM DI
New Plant Weekday Afternoon Peak Hour

METROPOLITAN POPULATION 2,900,000 — CYCLE TIME 80 SEC
RESIDENTIAL — CLRNC TIME 4 SEC

APPROACH	APPRCH WIDTH (FT)	% SLOWNG TURNS	% CNFLCT TURNS	% TRCKS	PEAK HOUR FCTR	LOAD FCTR	GEOM FCTR	CPCTY (VPHG)
Highland WB SRL	13.0	27.0	11.0	0.0	1.13	0.7	1.0	1,600
Crest NB SRL	13.0	1.0	27.0	7.0	1.04	0.7	1.0	1,040
Revere EB SRL	21.0	15.0	62.0	0.0	1.12	0.7	1.0	2,600
Revere SB SRL	21.0	53.0	6.0	3.0	1.11	0.7	1.0	2,830

GREEN TIME AS PRESENTLY APPORTIONED

APPROACH	APPRCH VLM (VPH)	EFF G/C	EFFCTV CPCTY (VPH)	V/C	SRVC LVL	DLY PER VEHICLE (SEC)	TOTAL DELAY (VH-HR)	AVG QUEUE (VEH)
Highland WB SRL	81	0.45	720	0.11	A	1.1	0.0	1
Crest NB SRL	360	0.45	468	0.77	C	25.9	2.6	5
Revere EB SRL	420	0.45	1,170	0.36	A	6.6	0.8	5
Revere SB SRL	843	0.45	1,274	0.66	B	19.7	4.6	10
INTERSECTION TOTALS	1,704		3,632	0.46	A		8.0	

SIGNALLED INTERSECTION ANALYSIS

MWRA DEER ISLAND TRFFC IMPACT — 301-04
Selectd-Hour Intersection Performance — 28 JUL 87
FJH

INTERSECTION OF Bennininton & Saratoga Streets
Expected Traffic Volumes: Condition F-6 — +24 TO DI
New Plant Weekday Afternoon Peak Hour

METROPOLITAN POPULATION 2,900,000 — CYCLE TIME 113 SEC
RESIDENTIAL — CLRNC TIME 4 SEC

APPROACH	APPRCH WIDTH (FT)	% SLOWNG TURNS	% CNFLCT TURNS	% TRCKS	PEAK HOUR FCTR	LOAD FCTR	GEOM FCTR	CPCTY (VPHG)
Bennington NB SRL	25.0	51.0	4.0	4.0	1.06	1.0	1.0	2,430
Bennington NB Right	13.0	100.0	0.0	4.0	1.17	0.7	1.0	1,340
Bennington SB SRL	27.0	14.0	35.0	4.0	1.02	0.7	1.0	2,050
Saratoga EB SRL	40.0	4.0	12.0	0.0	1.13	0.7	1.0	4,310
Saratoga WB SRL	22.0	24.0	46.0	2.0	1.10	0.7	1.0	2,520
Saratoga WB Left Sn	22.0	70.0	0.0	2.0	1.10	0.7	1.0	3,150

GREEN TIME AS PRESENTLY APPORTIONED

APPROACH	APPRCH VLM (VPH)	EFF G/C	EFFCTV CPCTY (VPH)	V/C	SRVC LVL	DLY PER VEHICLE (SEC)	TOTAL DELAY (VH-HR)	AVG QUEUE (VEH)
Bennington NB SRL	666	0.28	680	0.98	E	39.4	7.3	7
Bennington NB Right	342	0.42	563	0.61	B	17.1	1.6	6
Bennington SB SRL	298	0.28	574	0.52	A	12.8	1.1	3
Saratoga EB SRL	335	0.22	948	0.35	A	6.3	0.6	4
Saratoga WB SRL	316	0.22	554	0.57	A	15.1	1.3	4
Saratoga WB Left Sn	316	0.46	1,449	0.22	A	2.8	0.2	3
INTERSECTION TOTALS	2,273		4,768	0.47	A		12.1	

SIGNALLED INTERSECTION ANALYSIS

MWRA DEER ISLAND TRFFC IMPACT — 301-04
Selectd-Hour Intersection Performance — 28 JUL 87
FJH

INTERSECTION OF Main and Pleasant Streets
Expected Traffic Volumes; Condition F-6 — +24 TO DI
New Plant Weekday Afternoon Peak Hour

METROPOLITAN POPULATION 2,900,000 — CYCLE TIME 94 SEC
RESIDENTIAL — CLRNC TIME 4 SEC

APPROACH	APPRCH WIDTH (FT)	% SLOWNG TURNS	% CNFLCT TURNS	% TRCKS	PEAK HOUR FCTR	LOAD FCTR	GEOM FCTR	CPCTY (VPHG)
Main EB SRL	28.0	31.0	0.0	3.0	1.18	0.7	1.0	4,460
Main EB Right	14.0	100.0	0.0	0.0	1.21	0.7	1.0	2,390
Main WB SRL	18.0	0.0	4.0	0.0	1.21	0.7	1.0	3,160
Pleasant NB SRL	14.0	12.0	87.0	0.0	1.35	0.7	1.0	1,850
Pleasant SB SRL	12.0	65.0	6.0	0.0	1.88	0.7	1.0	2,510

GREEN TIME AS PRESENTLY APPORTIONED

APPROACH	APPRCH VLM (VPH)	EFF G/C	EFFCTV CPCTY (VPH)	V/C	SRVC LVL	DLY PER VEHICLE (SEC)	TOTAL DELAY (VH-HR)	AVG QUEUE (VEH)
Main EB SRL	898	0.48	2,141	0.42	A	8.7	2.2	6
Main EB Right	278	0.31	741	0.38	A	7.3	0.6	5
Main WB SRL	312	0.48	1,517	0.21	A	2.6	0.2	4
Pleasant NB SRL	301	0.44	814	0.37	A	6.9	0.6	4
Pleasant SB SRL	17	0.13	326	0.05	A	0.6	0.0	1
INTERSECTION TOTALS	1,806		5,539	0.32	A		3.6	

SIGNALLED INTERSECTION ANALYSIS

MWRA DEER ISLAND TRFFC IMPACT — 301-04
Selectd-Hour Intersection Performance — 28 JUL 87
FJH

INTERSECTION OF Shirley and Revere Streets
Expected Traffic Volumes; Condition F-6 — +24 TO DI
New Plant Weekday Afternoon Peak Hour

METROPOLITAN POPULATION 2,900,000 — CYCLE TIME 68 SEC
RESIDENTIAL — CLRNC TIME 4 SEC

APPROACH	APPRCH WIDTH (FT)	% SLOWNG TURNS	% CNFLCT TURNS	% TRCKS	PEAK HOUR FCTR	LOAD FCTR	GEOM FCTR	CPCTY (VPHG)
Shirley NB RL	13.0	100.0	0.0	1.0	1.16	0.7	1.0	1,370
Revere EB SR	18.0	16.0	0.0	2.0	1.08	0.7	1.0	2,040
Revere EB Right	9.0	100.0	0.0	13.0	1.21	0.7	1.0	840
Revere WB SL	16.5	0.0	8.0	0.0	1.18	0.7	1.0	2,110

GREEN TIME AS PRESENTLY APPORTIONED

APPROACH	APPRCH VLM (VPH)	EFF G/C	EFFCTV CPCTY (VPH)	V/C	SRVC LVL	DLY PER VEHICLE (SEC)	TOTAL DELAY (VH-HR)	AVG QUEUE (VEH)
Shirley NB RL	172	0.35	480	0.36	A	6.6	0.3	2
Revere EB SR	591	0.53	1,081	0.55	A	14.2	2.3	5
Revere EB Right	94	0.41	344	0.27	A	4.0	0.1	1
Revere WB SL	559	0.53	1,118	0.50	A	11.9	1.8	5
INTERSECTION TOTALS	1,416		3,023	0.46	A		4.5	

SIGNALLED INTERSECTION ANALYSIS

MWRA DEER ISLAND TRFFC IMPACT — 301-04
Selectd-Hour Intersection Performance — 29 JUL 87
FJH

INTERSECTION OF Veterans HWY & Shirley Street
Expected Traffic Volumes: Condition F-6 — +24 TO DI
New Plant Weekday Afternoon Peak Hour

METROPOLITAN POPULATION 2,900,000 — CYCLE TIME 80 SEC
RESIDENTIAL — CLRNC TIME 4 SEC

APPROACH	APPRCH WIDTH (FT)	% SLOWNG TURNS	% CNFLCT TURNS	% TRCKS	PEAK HOUR FCTR	LOAD FCTR	GEOM FCTR	CPCTY (VPHG)
Shirley EB SRL	12.0	34.0	17.0	10.0	1.14	0.7	1.0	1,180
Shirley WB SRL	13.0	6.0	3.0	0.0	1.22	0.7	1.0	2,620
Veterans NB SRL	16.0	8.0	64.0	7.0	1.24	0.7	1.0	2,040
Veterans SB SRL	16.0	39.0	17.0	5.0	1.31	0.7	1.0	2,130

GREEN TIME AS PRESENTLY APPORTIONED

APPROACH	APPRCH VLM (VPH)	EFF G/C	EFFCTV CPCTY (VPH)	V/C	SRVC LVL	DLY PER VEHICLE (SEC)	TOTAL DELAY (VH-HR)	AVG QUEUE (VEH)
Shirley EB SRL	292	0.45	531	0.55	A	14.2	1.2	3
Shirley WB SRL	36	0.45	1,179	0.03	A	0.6	0.0	1
Veterans NB SRL	158	0.45	918	0.17	A	1.9	0.1	2
Veterans SB SRL	143	0.45	959	0.15	A	1.6	0.1	2
INTERSECTION TOTALS	629		3,587	0.17	A		1.4	

SIGNALLED INTERSECTION ANALYSIS

MWRA DEER ISLAND TRFFC IMPACT — 301-04
Selectd-Hour Intersection Performance — 28 JUL 87
FJH

INTERSECTION OF Veterans HWY & Washington Avenue
Expected Traffic Volumes; Condition F-6 — +24 TO DI
New Plant Weekday Afternoon Peak Hour

METROPOLITAN POPULATION 2,900,000 — CYCLE TIME 80 SEC
RESIDENTIAL — CLRNC TIME 4 SEC

APPROACH	APPRCH WIDTH (FT)	% SLOWNG TURNS	% CNFLCT TURNS	% TRCKS	PEAK HOUR FCTR	LOAD FCTR	GEOM FCTR	CPCTY (VPHG)
Washington EB SRL	20.0	0.0	10.0	1.0	1.20	0.7	1.0	3,280
Washington WB SRL	26.0	5.0	0.0	2.0	1.15	0.7	1.0	4,350
Veterans SB SRL	22.0	100.0	0.0	19.0	1.27	0.7	1.0	1,970

GREEN TIME AS PRESENTLY APPORTIONED

APPROACH	APPRCH VLM (VPH)	EFF G/C	EFFCTV CPCTY (VPH)	V/C	SRVC LVL	DLY PER VEHICLE (SEC)	TOTAL DELAY (VH-HR)	AVG QUEUE (VEH)
Washington EB SRL	387	0.45	1,476	0.26	A	3.7	0.4	5
Washington WB SRL	287	0.45	1,958	0.15	A	1.6	0.1	3
Veterans SB SRL	146	0.45	887	0.16	A	1.7	0.1	2
INTERSECTION TOTALS	820		4,321	0.18	A		0.6	

SIGNALLED INTERSECTION ANALYSIS

MWRA DEER ISLAND TRFFC IMPACT — 301-04
Selectd-Hour Intersection Performance — 28 JUL 87
FJH

INTERSECTION OF Shirley Street & Washington Avenue
Expected Traffic Volumes: Condition F-6 — +24 TO DI
New Plant Weekday Afternoon Peak Hour

METROPOLITAN POPULATION 2,900,000 — CYCLE TIME 80 SEC
RESIDENTIAL — CLRNC TIME 4 SEC

APPROACH	APPRCH WIDTH (FT)	% SLOWNG TURNS	% CNFLCT TURNS	% TRCKS	PEAK HOUR FCTR	LOAD FCTR	GEOM FCTR	CPCTY (VPHG)
Washington EB SRL	26.0	77.0	0.0	6.0	1.19	0.7	1.0	4,040
Shirley NB SRL	24.0	13.0	76.0	1.0	1.12	0.7	1.0	2,000
Shirley SB SRL	20.0	61.0	7.0	5.0	1.03	0.7	1.0	2,460

GREEN TIME AS PRESENTLY APPORTIONED

APPROACH	APPRCH VLM (VPH)	EFF G/C	EFFCTV CPCTY (VPH)	V/C	SRVC LVL	DLY PER VEHICLE (SEC)	TOTAL DELAY (VH-HR)	AVG QUEUE (VEH)
Washington EB SRL	449	0.45	1,818	0.25	A	3.5	0.4	5
Shirley NB SRL	285	0.45	900	0.32	A	5.3	0.4	3
Shirley SB SRL	114	0.45	1,107	0.10	A	1.0	0.0	1
INTERSECTION TOTALS	848		3,825	0.22	A		0.8	

SIGNALLED INTERSECTION ANALYSIS

MWRA DEER ISLAND TRFFC IMPACT — 301-04
Selectd-Hour Intersection Performance — 28 JUL 87
FJH

INTERSECTION OF Veterans Road & Winthrop Shore Drive
Expected Traffic Volumes; Condition F-6 — +24 TO DI
New Plant Weekday Afternoon Peak Hour

METROPOLITAN POPULATION 2,900,000 — CYCLE TIME 80 SEC
RESIDENTIAL — CLRNC TIME 4 SEC

APPROACH	APPRCH WIDTH (FT)	% SLOWNG TURNS	% CNFLCT TURNS	% TRCKS	PEAK HOUR FCTR	LOAD FCTR	GEOM FCTR	CPCTY (VPHG)
Veterans EB RL	13.0	100.0	0.0	1.0	1.17	0.7	1.0	2,120
Winthrop NB SL	20.0	0.0	13.0	0.0	1.03	0.7	1.0	2,940
Winthrop SB SR	20.0	38.0	0.0	6.0	1.06	0.7	1.0	2,660

GREEN TIME AS PRESENTLY APPORTIONED

APPROACH	APPRCH VLM (VPH)	EFF G/C	EFFCTV CPCTY (VPH)	V/C	SRVC LVL	DLY PER VEHICLE (SEC)	TOTAL DELAY (VH-HR)	AVG QUEUE (VEH)
Veterans EB RL	82	0.45	954	0.09	A	0.9	0.0	1
Winthrop NB SL	275	0.45	1,278	0.22	A	2.8	0.2	3
Winthrop SB SR	428	0.45	1,197	0.36	A	6.6	0.8	5
INTERSECTION TOTALS	785		3,429	0.22	A		1.0	

SIGNALLED INTERSECTION ANALYSIS

MWRA DEER ISLAND TRFFC IMPACT — 301-04
Selectd-Hour Intersection Performance — 28 JUL 87
FJH

INTERSECTION OF Crest, Highland, and Revere
Expected Traffic Volumes: Condition F-2 — +24 TO DI
Do-Nothing Weekday Afternoon Peak Hour

METROPOLITAN POPULATION 2,900,000 — CYCLE TIME 80 SEC
RESIDENTIAL — CLRNC TIME 4 SEC

APPROACH	APPRCH WIDTH (FT)	% SLOWNG TURNS	% CNFLCT TURNS	% TRCKS	PEAK HOUR FCTR	LOAD FCTR	GEOM FCTR	CPCTY (VPHG)
Highland WB SRL	13.0	27.0	11.0	0.0	1.13	0.7	1.0	1,600
Crest NB SRL	13.0	1.0	35.0	0.0	1.04	0.7	1.0	1,080
Revere EB SRL	21.0	15.0	62.0	0.0	1.12	0.7	1.0	2,600
Revere SB SRL	21.0	53.0	6.0	3.0	1.11	0.7	1.0	2,830

GREEN TIME AS PRESENTLY APPORTIONED

APPROACH	APPRCH VLM (VPH)	EFF G/C	EFFCTV CPCTY (VPH)	V/C	SRVC LVL	DLY PER VEHICLE (SEC)	TOTAL DELAY (VH-HR)	AVG QUEUE (VEH)
Highland WB SRL	81	0.45	720	0.11	A	1.1	0.0	1
Crest NB SRL	272	0.45	486	0.56	A	14.6	1.1	3
Revere EB SRL	420	0.45	1,170	0.36	A	6.6	0.8	5
Revere SB SRL	843	0.45	1,274	0.66	B	19.7	4.6	10
INTERSECTION TOTALS	1,616		3,650	0.44	A		6.5	

WATER RESOURCES AUTHORITY
MASSACHUSETTS